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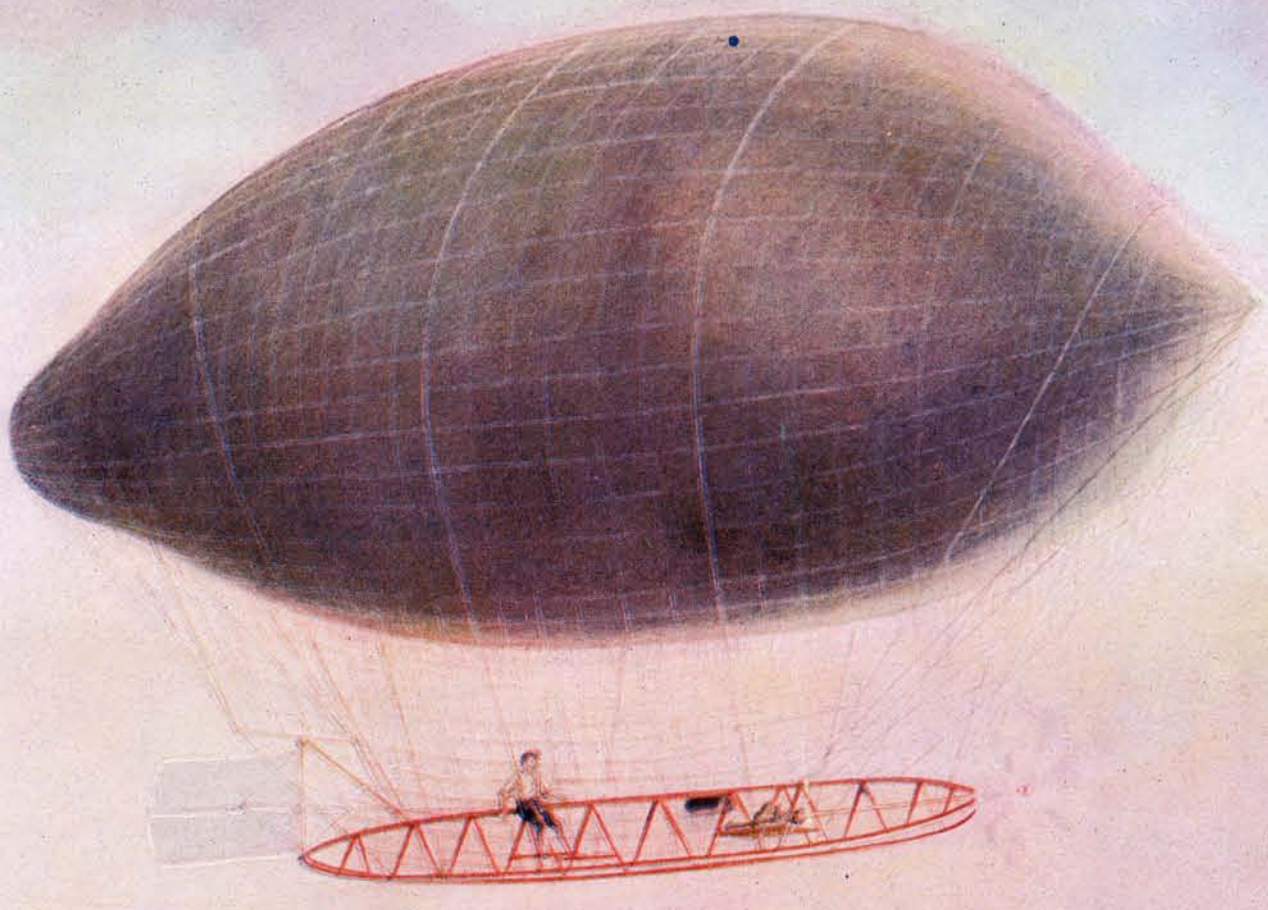

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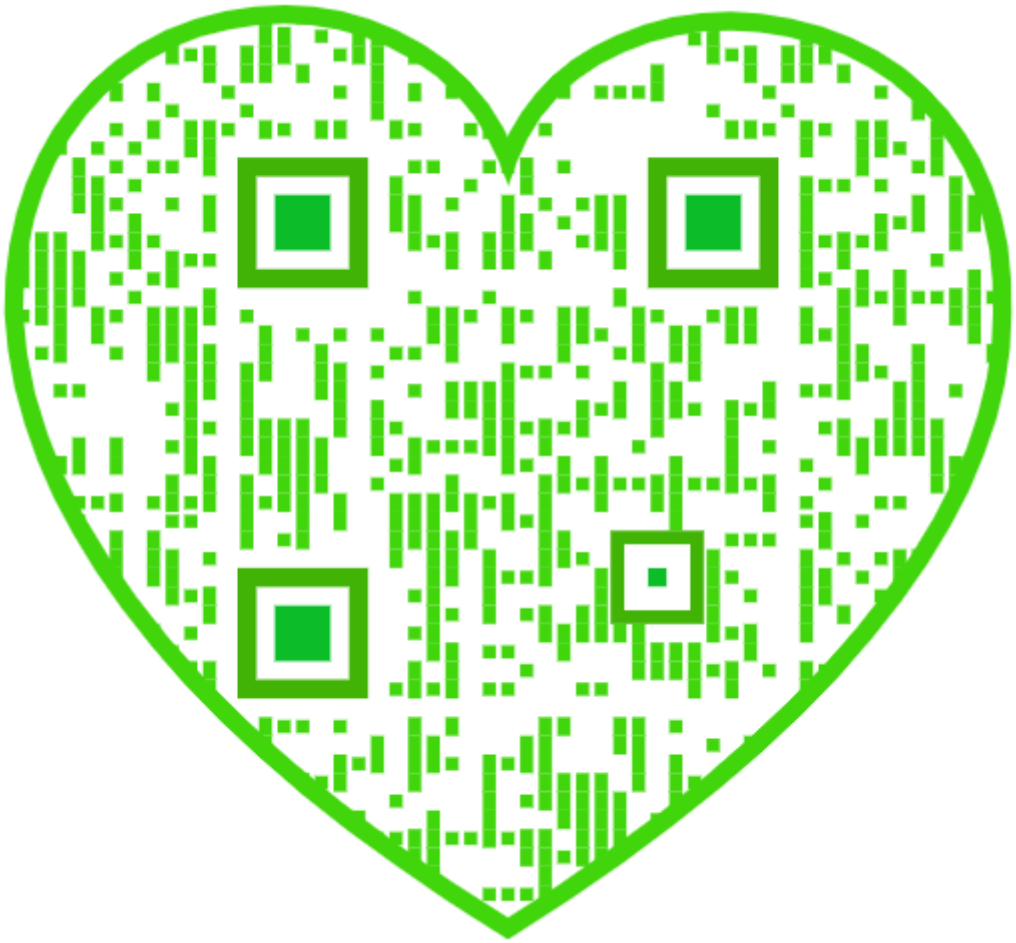

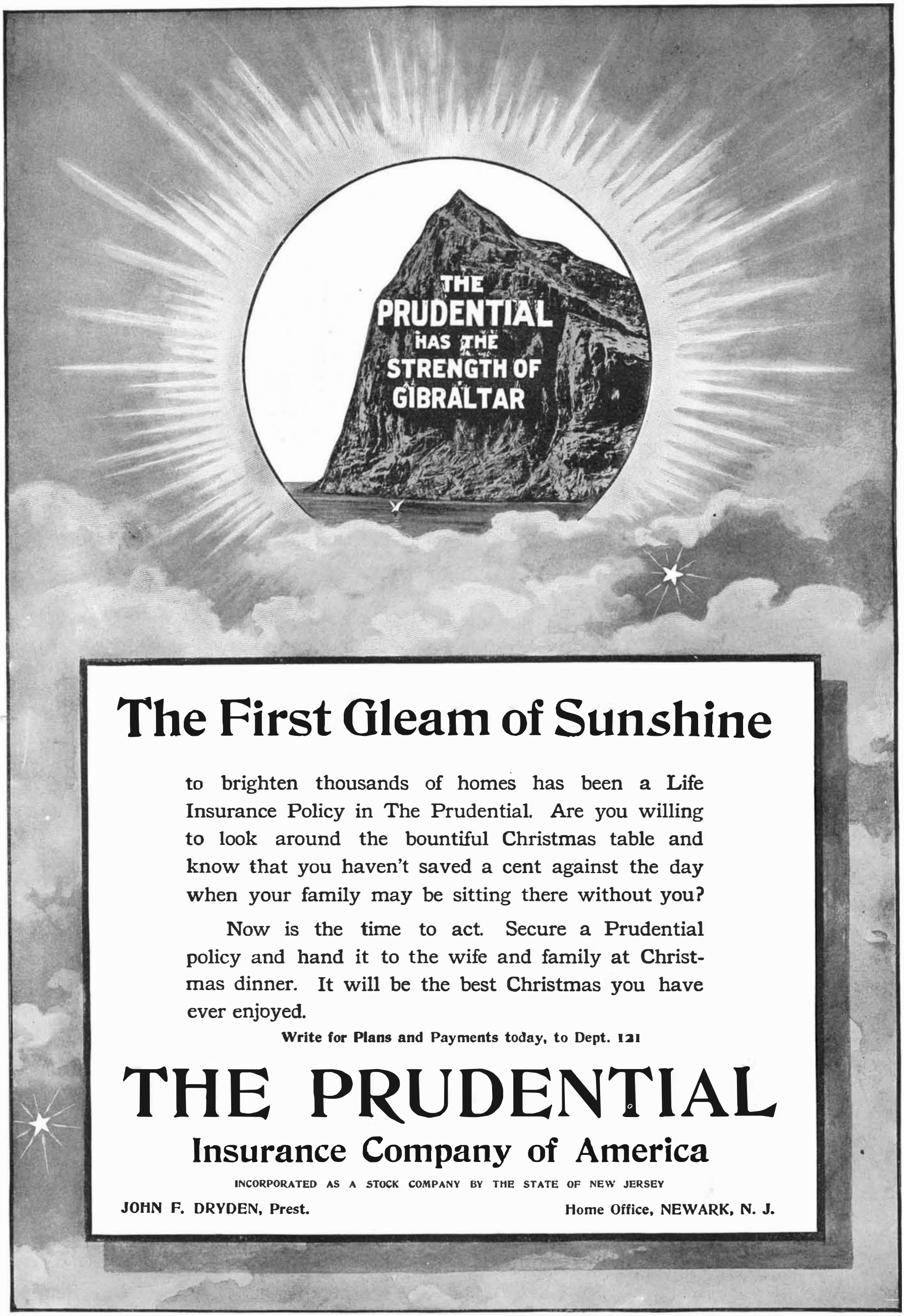

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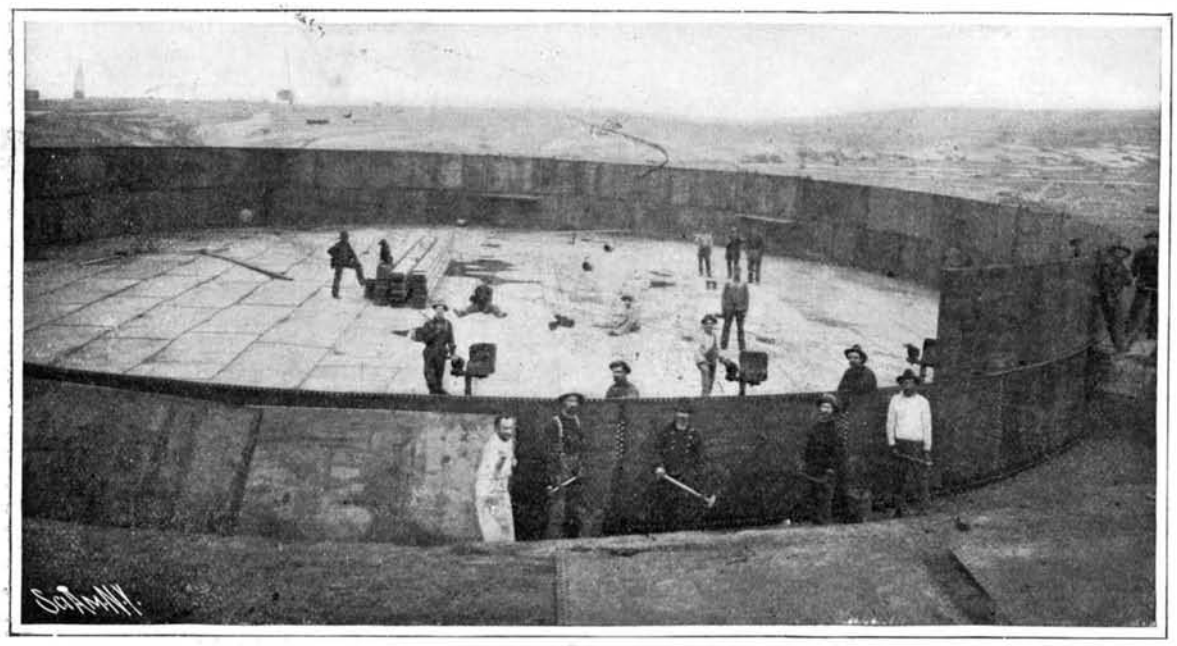
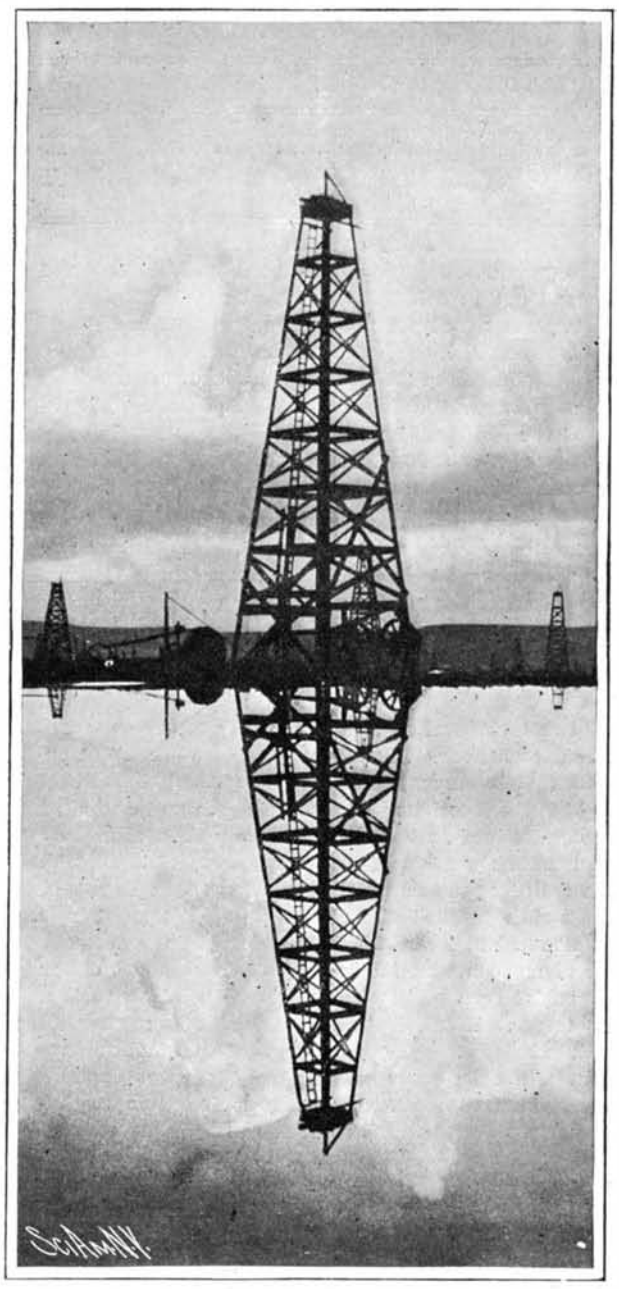
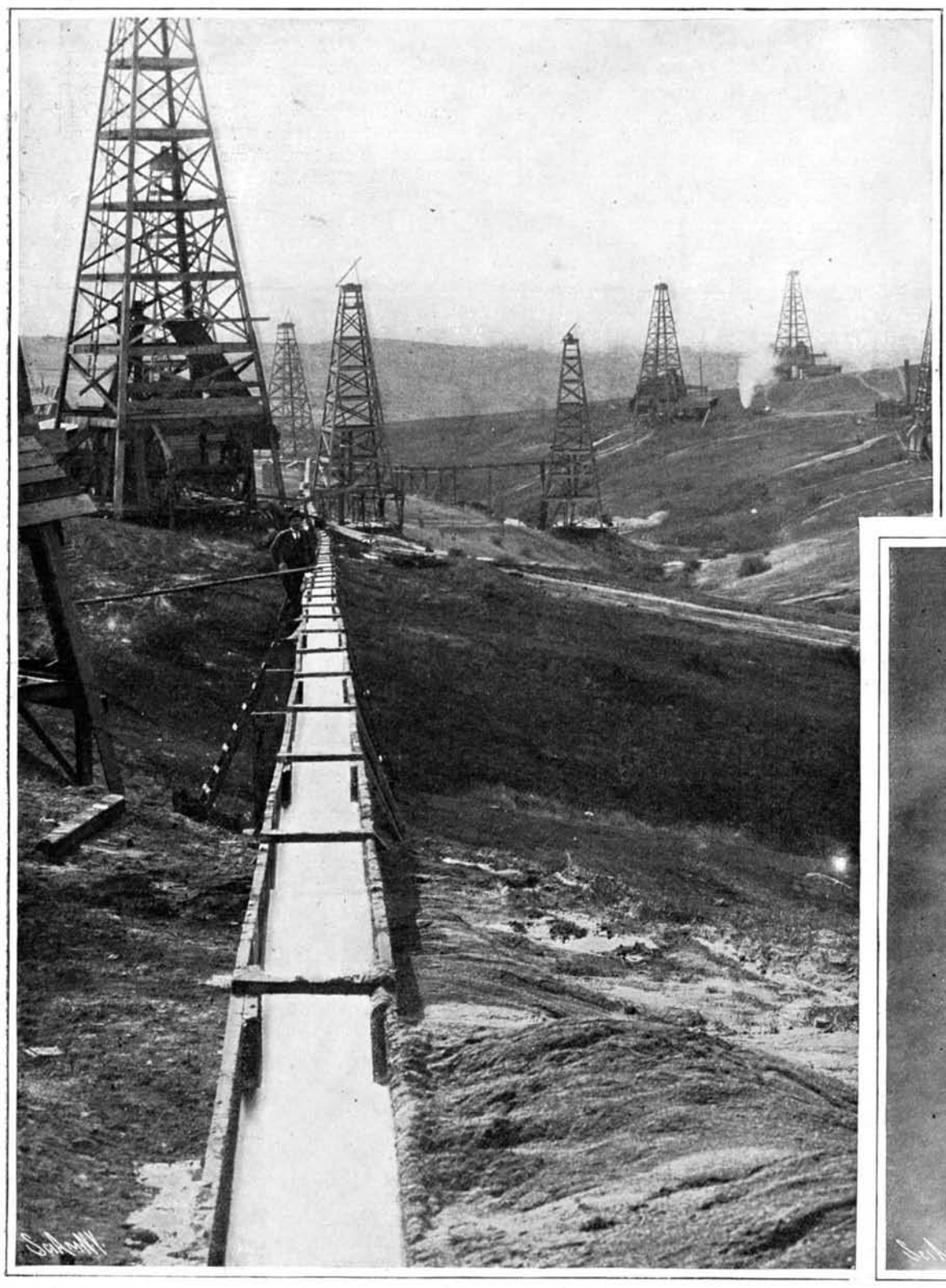


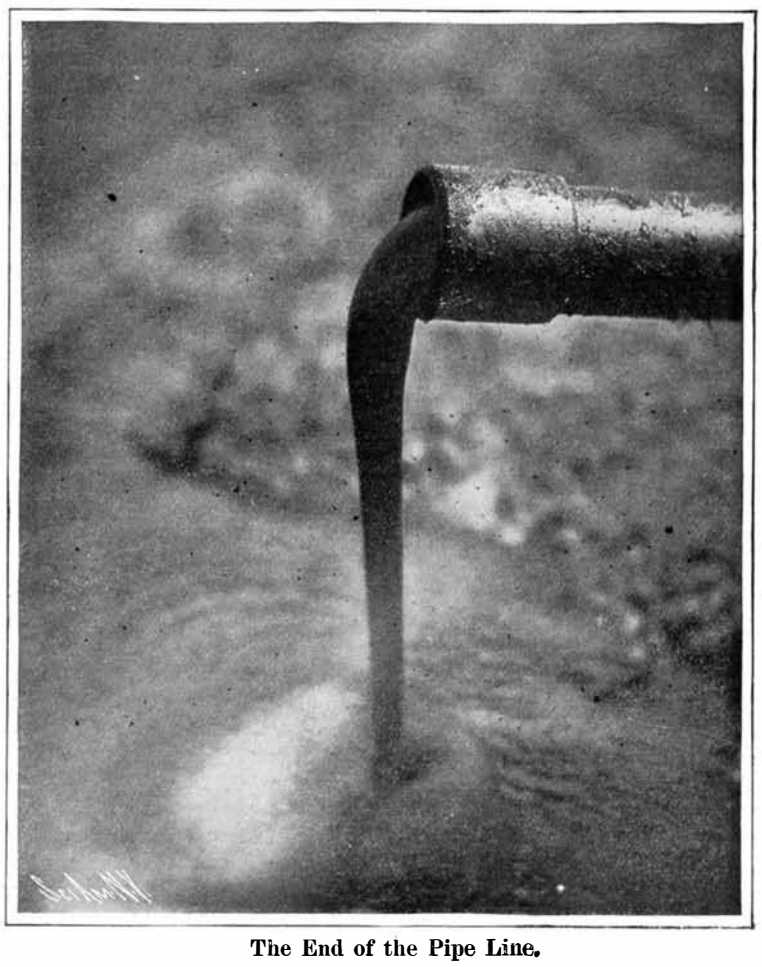
Building a 35,000-Barrel Oil Tank.



A Study in Oil.



An Oil Flume.



The End of the Pipe Line.

THE OIL FIELDS OF THE WEST.—[See page 484.]

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NEW YORK, SATURDAY, DECEMBER 16, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RETROSPECT OF THE YEAR 1905.

The year that is now drawing to a close is destined to stand out in bold relief as having witnessed some of the most momentous events in the world's history. The first of these, the peace of Portsmouth, marked the gathering in of the fruits of the stupendous naval and military struggle in the Far East, and the formal entry of the Japanese people into the front rank of the great powers of the world. By that treaty Japan won for China and for herself all, and more than all, for which she took up arms, and thereby added valuable political and strategetical advantages to the moral and military prestige that she had secured by her successful prosecution of the war. The indirect results of the struggle, however, are greater than those for which the war was fought; for if we read the signs of the times aright, it will be to the disasters in Manchuria and in the Sea of Japan that Russia will be indebted for the social and political upheaval of which we are witness at this very hour. Much as we deplore the awful excesses that accompany this struggle, it is our belief that out of it the Russians will emerge a free and contented people, destined to hold more securely than ever their commanding position among the nations of the world. It is entirely possible that the signing of the Treaty of Portsmouth marked the close of the last great war to be waged between civilized powers. The enormous cost of modern war, its liability to bring about either a financial or a political cataclysm, has given to it a new terror. Kings, Parliaments, and Congresses will hesitate before they resort to arms as the final arbitrament. An even surer preventive of war, and a most hopeful sign of permanent peace, is found in the increasing tendency of the nations to fraternize as man with man. Such incidents as the recent extraordinarily friendly receptions accorded to visiting foreign fleets, and particularly the cordial fraternization of the crews as seen in France and in this country, have a profound significance. Can it be that the era of universal peace has already stolen in upon us unannounced?

THE PANAMA CANAL.

We shall not be charged with having an undue estimate of the importance of the Panama Canal, if we state that this is one of the most serious problems, political, commercial, or military, confronting this country to-day; nor shall we be accused of undue pessimism if we suggest that the way in which we have handled this great problem during the past few months has added nothing to our reputation for constructive and executive ability in a work of this magnitude. There have been resignations without number, including that of the Chief Engineer; we have appointed Boards of Control, only summarily to disband them; we have spent ten million dollars, even before we know what kind of a canal we intend to build, or by what particular method we will build it; and finally, after calling together an advisory board composed of the most representative engineers of the world, in order that they may tell us just what kind of a canal we should construct, we are hysterically threatening to ignore their decision even before they have had time officially to render it. The SCIENTIFIC AMERICAN is of the opinion that there are just three things for the United States to do, if it is to maintain its national dignity and successfully carry through this gigantic work: the first is to accept without question the type of canal recommended by the Board; the second, is to let the whole work by contract under the absolute supervision of a Chief Engineer; and the third is to vote him ungrudgingly the appropriations which are necessary to carry on the work upon the scale, and by the methods, that he shall determine. If this be done, the United States within a single decade, will possess a sea-level canal, deep enough and broad enough for any possible development in the size of the ships of the future, and capable of giving them unhindered passage from the Atlantic to the one tidal lock on the Pacific. Moreover, if these conditions are fulfilled, we are satisfied that a sea-level canal will be placed at the service of the country in practically the same time as one built with locks and having the same capacity.

ASTRONOMY.

The astronomer must surely have found the past year sufficiently eventful. Among the more important achievements may be mentioned the discovery of two new satellites of Jupiter at Lick Observatory by Prof. Perrine. Although the sizes of the bodies have been computed and likewise the inclination of their planes to the orbit of the parent planet we must wait a year or two for more definite information as to the direction of their movement—in other words until Jupiter has moved a considerable distance so that the angles of the orbits may be computed from different positions.

No less remarkable is the discovery of a tenth satellite of Saturn by Prof. Pickering—remarkable because the discovery was the culmination of mathematical research and a painstaking study of photographs extending over several years. This new satellite of Saturn has an estimated diameter of 200 miles and is just beyond telescopic vision, for which reason its presence can be detected only by the sensitive photographic plate. The acrimonious controversy which has been waged over the existence of the problematical canals of Mars seems at last to have been settled by photography. Prof. Lowell, one of the stanchest advocates of the existence of the Martian canals, has advanced what seems most invincible photographic proof that the canals are not merely optical illusions or the result of eye-strain. Under his direction, Mr. Lampland, of the Flagstaff observatory, has secured some excellent chronophotographs of the much discussed phenomena.

Perhaps the most dramatic celestial occurrence of the year was the total solar eclipse of August 30. Unfortunately the elaborate plans which had been made for comparatively studying and photographing the corona at the beginning of the eclipse, in Labrador, and at its height in Spain and Africa were frustrated. An overcast sky rendered any attempt at observation in Labrador quite vain. In Europe and Africa, on the other hand, the weather seems to have been favorable. This was the first effort which has ever been made to study the corona systematically at the beginning and end of the eclipse path, for the purpose of discovering any possible fluctuations in the appearance of the coronal streamers. From the lunar eclipse of August 14 little was expected that would be new, for which reason the phenomenon was practically ignored.

CIVIL ENGINEERING.

In the world of civil engineering, and in the now closely-allied field of architecture, the most significant fact is the truly marvelous development that is taking place in the use of steel-and-concrete, or armored concrete, construction. Its economy, reliable strength, convenience and rapidity of construction, and the extraordinarily wide range of work in which it may be utilized, render it certain that concrete-steel will exert a more powerful influence within the field of the civil engineer, than any single invention since the introduction of Bessemer steel.

During the year work has been satisfactorily prosecuted upon the great cantilever railroad and highway bridge across the St. Lawrence at Quebec. This structure with its main span of 1,800 feet, not only has the greatest capacity of any cantilever bridge yet constructed, but also embodies the largest single span, the next in size being the two 1,710-foot spans of the Forth Bridge. A notable feature of the year has been the growing popularity of the bascule bridge and the aerial bridge for the crossing of streams on which there is a frequent traffic. The popularity of the latter type is very marked, a notable instance being the new ferry at Duluth, with a span of 394 feet. An important bridge that has been completed during the year is the Victoria Falls Bridge over the Zambezi River, a trussed arch span of 500 feet, which forms a connecting link on the so-called Cape-to-Cairo railroad. With the exception of the Blackwell's Island Bridge across the East River, New York, the great structures planned across that river have made but little progress. The Blackwell's Island Bridge is completed as to its substructure, and the superstructure is now in course of erection. The Manhattan Suspension Bridge, after two years of delay, has been switched into the courts, and progress, at least on the superstructure, is at a standstill. The past year has witnessed the completion of some highly important tunnel work. First to be mentioned is the great Simplon tunnel through the Alps, in which the rock that separated the two headings was broken through on the 24th of February. The total length from portal to portal is 12¼ miles. The year's operation of the new tunnel between Boston and East Boston has been eminently satisfactory. This tunnel is 1.4 miles in length, and at its lowest point beneath the harbor the masonry is 82.3 feet below mean low water. In New York city, the Hudson Companies have completed the second or north tunnel of the twin tunnels between Jersey City and Morton Street, and at the Manhattan end the tunnels have been carried well on their way to Fourth Avenue and Thirty-third Street. In these tunnels a record has been established for rapid construction, and it is expected that the other twin tunnels located between Jersey City and Cortlandt and Fulton Streets, will be driven through with even greater rapidity. A most important event of the year was the completion of Chicago's freight, express, and mail subways; for upon the successful operation of the system will depend its extension to other cities. We believe that the congestion of vehicles on the streets of our great cities can never be relieved until heavy freight traffic is removed from the streets, and handled in a system of subways running at the level of the basement floors. During the latter part of the year gratifying progress has been made in dredging the great Ambrose Channel, 7 miles in length and 40 feet in depth, which is to form the future entrance to New York harbor. With the assistance of the two powerful government dredges which have recently been put upon the work, matters have so far progressed that, early in the spring, a 35-foot channel will be available, and probably within a year from date the depth will have been increased to 40 feet throughout. The great sea wall of Galveston, for the protection of that city against a repetition of the disaster of September 8, 1900, was completed during the year, and the work of filling in back of it, and thereby raising the grade of the city, has been steadily carried on. This huge concrete wall, which is 4½ miles in length and weighs 40,000 pounds to the lineal foot, measures 16 feet at the base, 17 feet in height, and is 5 feet across the crest. It is built upon 45-foot piles, and is protected from the undermining action of the Gulf storms by an apron of rip-rap, 27 feet in width. The grade of the city will ultimately be raised to the level of the top of the wall. An interesting coincidence in the field of civil engineering is the completion during the year of the two largest modern reservoirs built for city water supply, namely, the Wachusett reservoir for the supply of the city of Boston and the new Croton reservoir for the supply of New York city. The Wachusett reservoir dam extends 129 feet above ground level and 158 feet above its lowest foundation, and it impounds 63,000,000,000 gallons of water. The Croton dam extends 157 feet above ground level, 297 feet above its lowest foundation and it impounds 32,000,000,000 gallons. The Jerome Park reservoir, in New York, easterly basin has now been fully concreted and is ready to receive water. The important task of providing additional water supply for the future needs of New York city has been advanced by the passing of the necessary legislation. The Board of Water Supply has presented a report of the plan of its engineers to secure a daily additional supply of from 500 to 600,000,000 gallons of water. The scheme involves the construction of a great reservoir at Ashokan in the Esopus valley, and the construction of an aqueduct, passing beneath the Hudson, capable of delivering, as its maximum capacity, 500,000,000 gallons per day. The total estimated cost of this work is about $162,000,000. Work has been actively prosecuted on the government irrigation projects for the reclamation of arid western lands, and the State of Nevada has witnessed the inauguration of the great irrigation canal known as the Main Truckee Canal—a part of the Truckee-Carson project—which on June 17 received its first water from the Truckee River.

STEAM AND ELECTRICAL RAILROADS.

During the year, work has been prosecuted with considerable activity upon the two great terminal stations now being built in New York city by the New York Central and Pennsylvania Railroad companies. So far, the work in each case has been almost entirely one of excavation, and as the two schemes together call for the excavation and removal of between 4 and 5 million cubic yards of rock and earth, it can be seen what a gigantic task each company has set itself. The New York Central station excavation is about one-half completed, the two electrical power stations at Yonkers and Port Morris are well under way, and the widening of the roadbed up to Croton Landing is being completed as fast as the material is brought from the Forty-second Street excavation. The experimental work on the company's six-mile stretch of electrified track near Schenectady has yielded results very favorable to electric traction. A series of comparative tests between a 170-ton steam locomotive and the 100-ton type electric locomotive, hauling trains of identical make-up and weight, on parallel tracks, have shown a difference in favor of the electric locomotive of 30 feet 8½ inches in length, 72 tons in weight, 5¾ tons in concentrated weight on driving axles, 51¼ tons of revenue bearing load back of the locomotive, of 0.148 mile per hour acceleration, and of 76 seconds in the time necessary to reach a speed of 50 miles per hour. The fine results shown by the New York elevated railroads, after the motive power had been changed from steam to electricity, have been repeated in the operation of the New York Subway which, almost from the

day of its inauguration, has been an unqualified success. Save for some congestion in the first two or three weeks succeeding its opening, the Subway system has been running now for over a year with absolutely clock-like precision, and the speed, especially of the express trains, has been rather over than under the original estimate. During the year, the road has carried over 300,000 passengers per day. Already, however, it is becoming congested, the travel on a single day recently having risen as high as half a million in the twenty-four hours. Sixty miles of additional Subway lines have been authorized by the Rapid Transit Commission. A most serious problem encountered has been that of ventilation, the heat given off by the motors and by the brakes being sufficient to render the temperature almost insufferable during the hot summer weather. An important proposition made during the year with the indorsement and backing of some of the leading engineers and financiers of this city had in view the construction of a moving platform across Manhattan Island beneath Thirty-fourth Street. In the hearing before the Rapid Transit Board, the remarkable statement was made by Mr. Stilwell, the chief electrical engineer of the Interborough Railroad, that, estimating the rolling friction of the platform at about 6 pounds per ton, 10 kilowatts, instead of moving, as in the case of the Subway, ten passengers, would move 260 passengers on the moving platform, the difference being due to the small dead load, the absence of stopping, and the low coefficient of rolling friction. As an important preliminary to the operation of the Pennsylvania Railroad Terminal and Suburban System in New York by electric traction, a large section of the newly electrified Long Island suburban railroads was opened to the public at the close of the year. At the present time there is in operation a total mileage, when reduced to a single track basis, of about 100 miles; and during the next few months large additional stretches of track will be included in the electrically-operated zone. In all the work done hitherto around New York, the direct-current system has been used; but a mild sensation was produced by the recent announcement that the work of equipping the New York, New Haven and Hartford suburban and terminal lines in New York is to be carried out with the single-phase alternating current. The company has been encouraged to make this decision by the results obtained in the United States by the two interurban trolley roads upon which the single-phase alternating current system has been installed, one of these being a high-speed line between Indianapolis and Rushville, and the other a relatively low-speed line known as the Pontiac-Odell line. A valuable feature of the Westinghouse single-phase alternating current motors is that they will operate successfully when required with direct current; and accordingly the alternating current will be used on the New Haven tracks as far as Woodlawn, the motors drawing upon the direct current through the third-rail conductors on the 11-mile stretch of New York Central tracks from Woodlawn to the Grand Central station. It is impossible within the limits of this review to mention the steam railroads that are already equipping or proposing to equip their suburban and terminal service electrically, but the movement is widespread and we look to see within the next decade practically every great railroad so operated in the vicinity of all great cities.

Meanwhile the development of the steam locomotive is being studied with an enthusiasm which would indicate that the locomotive engineer, at any rate, has no fear of the immediate extinction of the old by the new method of traction. Perhaps the most marked feature of this development is the growth in favor of the use of superheated steam which, in the European locomotives that have been using it during the year, has shown economical results that are at least equal to, and in some cases better than those secured in compound locomotives that make no use of superheat. Compounding is again to the front, and the four-cylinder arrangement, with the high-pressure cylinders attached to the trailing and the low pressure cylinders attached to the leading axle, a type that is due to the celebrated French engineer De Glehn, seems likely to become the prevailing model. The De Glehn locomotives built for use on both English and American lines have shown highly satisfactory results, much of which is, no doubt, attributable to the Walschaert gear. The speed of express trains as a whole is about the same as it was last year, although a few special trains have been accelerated, and the length of some celebrated non-stop runs has been increased. The summer service of trains from Philadelphia to Atlantic City still remains the fastest in the world, with its average speeds of 66 to 68 miles per hour. Some remarkable non-stop high-speed runs have been made both in England and in this country, a notable instance being the Ocean Mail Special train on the Great Western, running between Plymouth and London, which ran from Exeter to London, a distance of 193¾ miles, without a stop, at an average speed of 71 miles an hour. The famous twenty-hour trains between New York and Chicago, both on the New York Central and Pennsylvania railroads, have been accelerated and placed under a schedule of eighteen hours, the former train covering 959.4 miles, at the rate of 53.3 miles an hour, and the latter covering 905.4 miles at the rate of 50.3 miles an hour. The longest non-stop trip by a regular train running under schedule is that of a train on the Great Western Railway which runs regularly between London and Plymouth, a distance of 245¾ miles, without a stop, at the average speed of 55.64 miles per hour. An important change that will gradually take place in the construction of passenger cars is the substitution of steel for wood. The first step in this direction was taken by the Illinois Central a few years ago, and it was followed on the New York Subway where the cars have proved a great success. Steel mail and baggage cars have been constructed; the New York Central and the Pennsylvania roads have given large orders for steel cars; and we understand that the Pullman Company proposes to manufacture all-steel cars for passenger service. The SCIENTIFIC AMERICAN has for many years been an earnest advocate of the steel car, mainly because we believe it would prove to be the greatest protection to the life and limb of the passengers of any device that has been introduced of late years into railroad service. Such protection is needed; for in spite of the extension of the block signal system, the number of casualties on our railroads is increasing far faster than the increase in passengers carried. The accident statistics of the Interstate Commerce Commission show that the number of passengers killed increased from 303 during the year in 1902 to 537 in 1905, while the number of injured passengers rose from 6,089 in 1902 to 10,040 in 1905. During the same period the number of employes killed rose from 2,516 to 3,261, and the number of injured from 33,711 to 45,426.

NAVAL AND MILITARY.

It goes without saying that the most important event in the annals of naval and military affairs during the past year was the great battle of the Sea of Japan. It was the decisive event for which students of naval warfare had been waiting these many years past; for unlike the battle of August 10, this was a struggle in which neither side hesitated to close in for the final arbitrament of gun against armor. On each side were battleships which embodied the most up-to-date practice of the leading naval architects of the world. The battle was fought at ranges at which the guns could get in their most effective work; and every type of modern warship with the exception of the submarine was given an opportunity to prove itself. The result was first and last a triumph for a highly trained personnel over one greatly inferior. What Russian ships were not sunk by gun fire succumbed to the torpedo, or were captured by concentration of overwhelming forces of the enemy. At least two Russian ships were sunk by having the thinner secondary armor above the main belt blown bodily in upon the ship, or so badly perforated that, in rolling in the heavy sea that was running, the vessels shipped large quantities of water and sank comparatively early in the battle. Speaking broadly, the results of the war are a strong vindication of the theories upon which the modern types of fighting ships have been constructed. The progress of our own navy has been marked by the addition of a large number of battleships and armored cruisers of the first class. Practically the whole of the six armored cruisers of the "California" class are now available, while the powerfully armed and armored battleships of the "Rhode Island" class are rapidly having their trials and before many months all of them will be in commission. A most gratifying result is the rapidity with which the "Louisiana" at Newport News and the "Connecticut" at the Brooklyn navy yard have been pushed toward completion. At the present writing the "Connecticut," which is being built by the government, is about 93½ per cent completed, and the "Louisiana" is about 91½ per cent completed. The stimulating effect of government construction upon private yards is proved by the fact that these two ships are about as far advanced as the five battleships of the "Georgia" class, although the "Georgia" class was authorized in 1899, and the "Connecticut" class not until three years later. It is sincerely to be hoped that the policy of maintaining at least one warship under construction at our leading government yards will continue to be steadily followed. It certainly will be, if the interests of the nation at large are considered to be superior to that of the individual shipbuilding firms. Judging from the fine performance of the "Rhode Island" the "Georgia" class bid fair to make and exceed their contract speed of 19 knots an hour. The influence of the late war has made itself felt in the construction bureaus of the various navies. Already there seems to be an agreement among all the navies (except that of Japan, which surely ought to know best) to abolish intermediate caliber guns from the battleship, mounting only 12-inch guns, and a numerous battery of small rapid-firers to repel torpedo attack. The British are building a type battleship of 18,000 tons displacement which is to be driven at 21 knots speed by turbine engines, and is to mount ten 12-inch guns with a numerous battery of 12-pounders. The United States government is now debating whether to build an 18,000-ton ship with ten 12-inch, or a 16,000-ton ship with eight 12-inch, so disposed as to give a broadside superior to that of the ten-gun ship. Germany and Russia are credited with designs with similar innovations. The new Japanese battleships which will soon be completed carry four 12's, four 10's, and twelve 6's. A most important change in the relative battleship power of the world's navies has been made by the recent refloating of Russian warships sunk at Port Arthur and their addition to the Japanese navy, which now possesses nine battleships and nine armored cruisers. With the addition of the new 16,000-ton battleships now building in England, Japan will possess a great preponderance in ships-of-the-line over any other nation in the Pacific. The effect of the addition of the Port Arthur ships to the Japanese navy, moreover, has been to give Japan a distinct lead over Italy, and place her in the fifth position among the navies of the world, or next to the United States. The progress of the submarine has been marked by many vicissitudes; for although it has shown in the various maneuvers, specially those carried out with the larger types in France and Great Britain, that it is an element of naval warfare that has to be recognized and reckoned with, the year has been marked by some terrible disasters. It is but fair to state, however, that the latter were due more to inefficient handling and inexperience than to inherent defects in design. In the development of artillery, there is a steady increase in the length of guns and in the capacity of powder chambers, with a consequent rise in velocities and energies. At Sandy Hook the army has been testing two 6-inch, wire-wound guns, both of which have shown velocities in the neighborhood of 3,300 feet per second. As was to be expected these high velocities were attended with erosion trouble. Erosion is the problem which above all others is demanding solution at the present time; for until it has been solved, the artillerist will have to seek for increased energy by increasing the weight of the gun and projectile, rather than by raising the velocity. The wire-wound gun continues to more than hold its own with the hooped gun, and the probability is that as pressures increase it will become the ultimate prevailing type.

MERCHANT MARINE.

Judged by the ships that have been put in service during the present year, the tendency among the transatlantic steamship companies is to build combined freight and passenger steamships of moderate speed and large carrying capacity, rather than high-speed vessels such as the "Lucania," "Deutschland," and "Kaiser Wilhelm," in which the demands of the motive power for space prohibit the carrying of cargo. On the other hand the North German Lloyd Company has given orders for the construction of another 23½-knot steamer of the same size as the "Kaiser Wilhelm II.," and the Cunard Company has under construction two 25-knot vessels that are to be about 800 feet in length. During the year, three vessels of the largest size have been added to the already large fleets that trade with American ports. In March of this year the new steamship "Coronia" of the Cunard line made her maiden trip, and as we go to press the "Carmania," a sister vessel, is on her maiden trip to New York. The "Coronia," driven by reciprocating engines, made on her trial a speed of 19.5 knots, and the "Carmania" made about a knot more, or 20.43 knots on her trial trip. In the spring of the year the American-built 15-knot "Dakota," 630 feet in length, a sister of the "Minnesota," sailed from New York for Seattle to make her maiden trip from Seattle to Japan. Toward the close of October the Hamburg-American line dispatched to New York the new twin-screw 17-knot liner "Amerika," a vessel of the same popular passenger-and-cargo type, which is remarkable for the extraordinary richness and novelty of her appointments. The increase in size of transatlantic ships has had its counterpart in some of the huge cargo vessels that have been turned out this year for the ore-carrying trade on the Great Lakes. Among these are four vessels, known as the "Gary," "Corey," "Perkins," and "Frick," which are each 569 feet long, and are estimated to carry about 15,000 tons of ore at a single trip. There has been a steady advance in the application of devices to render travel upon the high seas more safe, chief among which may be mentioned the method of closing all bulkhead doors from the navigation bridge, the further extension of wireless telegraphy, without which no ocean steamer is to-day considered to be fully equipped, and the introduction of the system of signaling under water by means of the submarine bell. This last may be considered as one of the most important safeguards yet introduced against

(*Continued on page 479.*)

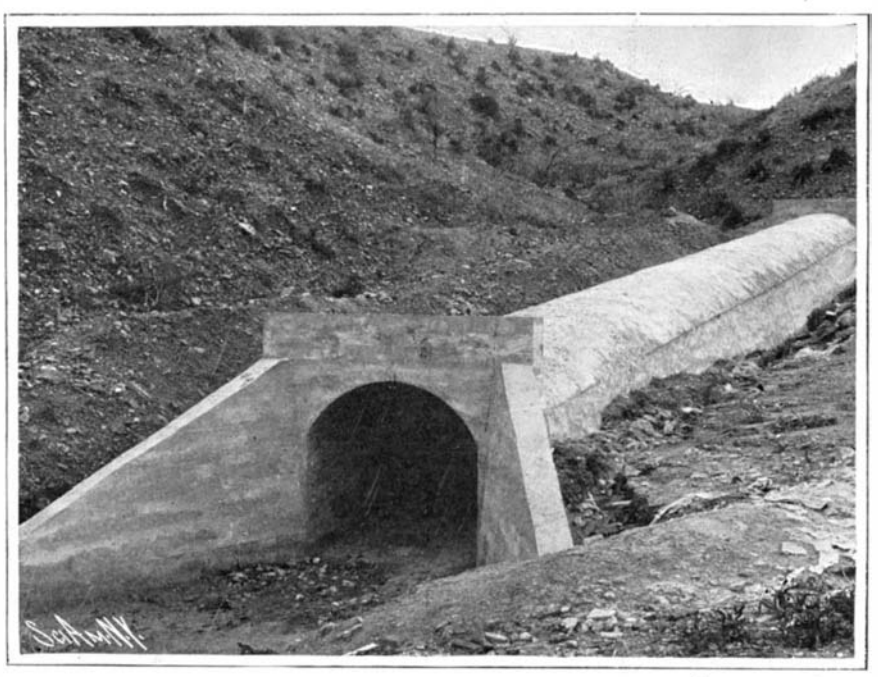
THE ROOSEVELT IRRIGATION DAM IN ARIZONA.

Of the fund of $25,000,000 at present available for irrigation projects in this country under supervision of the government engineers, $3,000,000 have been appropriated for a system which will probably be the most extensive of its kind. This is commonly known by two titles—the Tonto reservoir and the Roosevelt dam. The latter title has been appropriately given in recognition of the encouragement which President Roosevelt has shown toward the reclamation of our arid territory.

The Tonto reservoir, which will be fed by the stream of this name and the Salt River, will serve to irrigate what is known as the valley of the Salt River, which in its natural state is one of the most barren sections of America, being practically a desert, except where it is now watered by the few systems in existence, taking water from the Salt River. It is located largely in Maricopa County, Arizona. The dam itself will be erected in Gila County, about 65 miles northeast of Phœnix. At this point a natural site is afforded by a cañon formation. Here the gorge is but 200 feet wide at the base, expanding to 400 feet in width at the top of the cliffs. By the construction of a barrier of the dimensions proposed, a reservoir will be formed, about 18 miles in length and averaging 4 miles in width. While this area is less than that of some of the storage reservoirs already completed in this country, it will contain sufficient water to flood 1,300,000 acres to an average depth of one foot—far exceeding the largest Nile reservoir in the volume of water retained.

The dam from foundation to crest will be at least 250 feet in height, and will range in thickness from 165 feet at the bottom to 16 feet at the top, or be wide enough to provide a highway for vehicles, which is included in the plans. The maximum depth of water in the reservoir will be nearly 200 feet. The dam will, of course, rest upon a bed of solid rock, and a large amount of excavation will be necessary in order to obtain such a foundation.

The great magnitude of the work accounts for the fact that although operations were begun upon the project over a year ago, as yet only the preliminary details have been carried out. As the photographs show, these are of no little importance in themselves. Owing to the character of the country, it was necessary to construct a series of highways, in order to haul machinery and other supplies to the site of the dam from the nearest railway point. Road-building operations have covered nearly 100 miles alone, some of the highways being cut through bluffs ranging from 50 to 75 feet in height. The highway system includes one around the edge of the basin, in order that all parts of the reservoir may be accessible for inspection and repairs, if needed. The immense amount of rock cutting, the quantity of cement needed, also the elaborate concrete work, rendered necessary the construction of a large cement mill, several concrete mixing plants at various points, as well as smaller industries, which have created a village in the vicinity of the dam site, this community also being called Roosevelt. An odd feature of Roosevelt is that it is situated on the bottom of the proposed reservoir, and will pass out of existence as soon as the dam is completed. Owing to the difficulty in securing fuel and the expense of installing steam power, the engineers decided to utilize hydraulic and electric power, and a portion of the preliminary work has been the construction of a power canal, which is nearly 20 miles in length. It will generate sufficient current to operate all of the mechanism and that needed for illuminating the cement mill and other plants, and, if necessary, will furnish light for night work upon the dam itself. It is intended to employ electric motors in driving rock drills and other excavating machinery, also for the aerial cableways, and for the tramways, which will be employed in transferring material from the quarries and other points to the dam. The power canal has been constructed for permanent service. In completing it several tunnels were driven through the mountains, and several elaborate culverts were built. The latter have been constructed of concrete, while, in some cases, the tunnels have been lined with the same material. Concrete also has been used for the bottom and sides, in excavations where the earth formation is so soft that it is liable to be eroded by the action of the water. Another conduit three miles long has been built for supplying the town with water for drinking and other domestic purposes, as no natural supply is available in this vicinity. It may be needless to say that the auxiliary work includes a telephone system, by which communication is had with Phœnix.

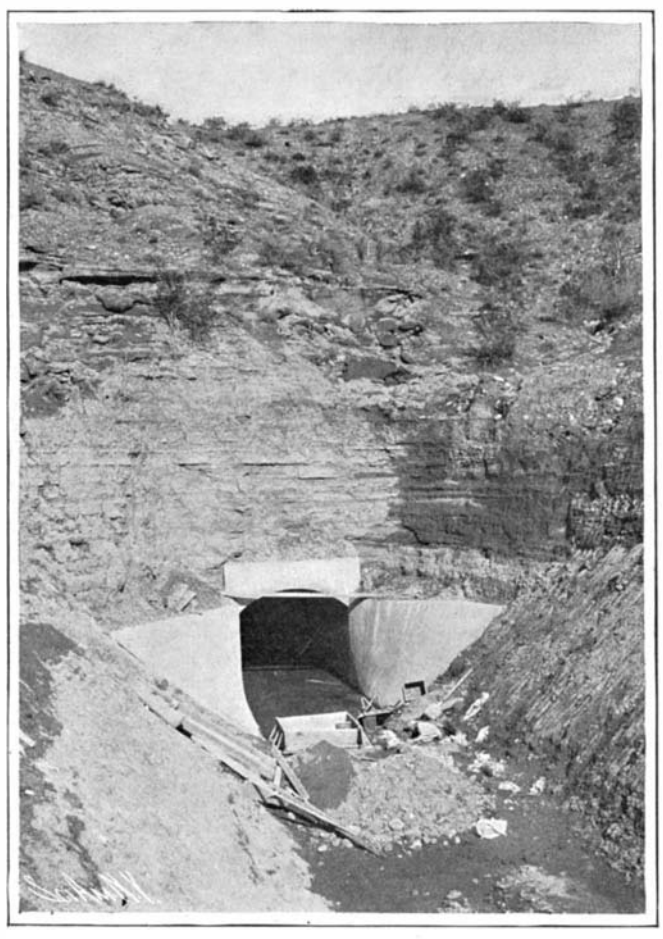


Large Culvert on Power Canal, Showing Substantial Character of the Concrete Work.

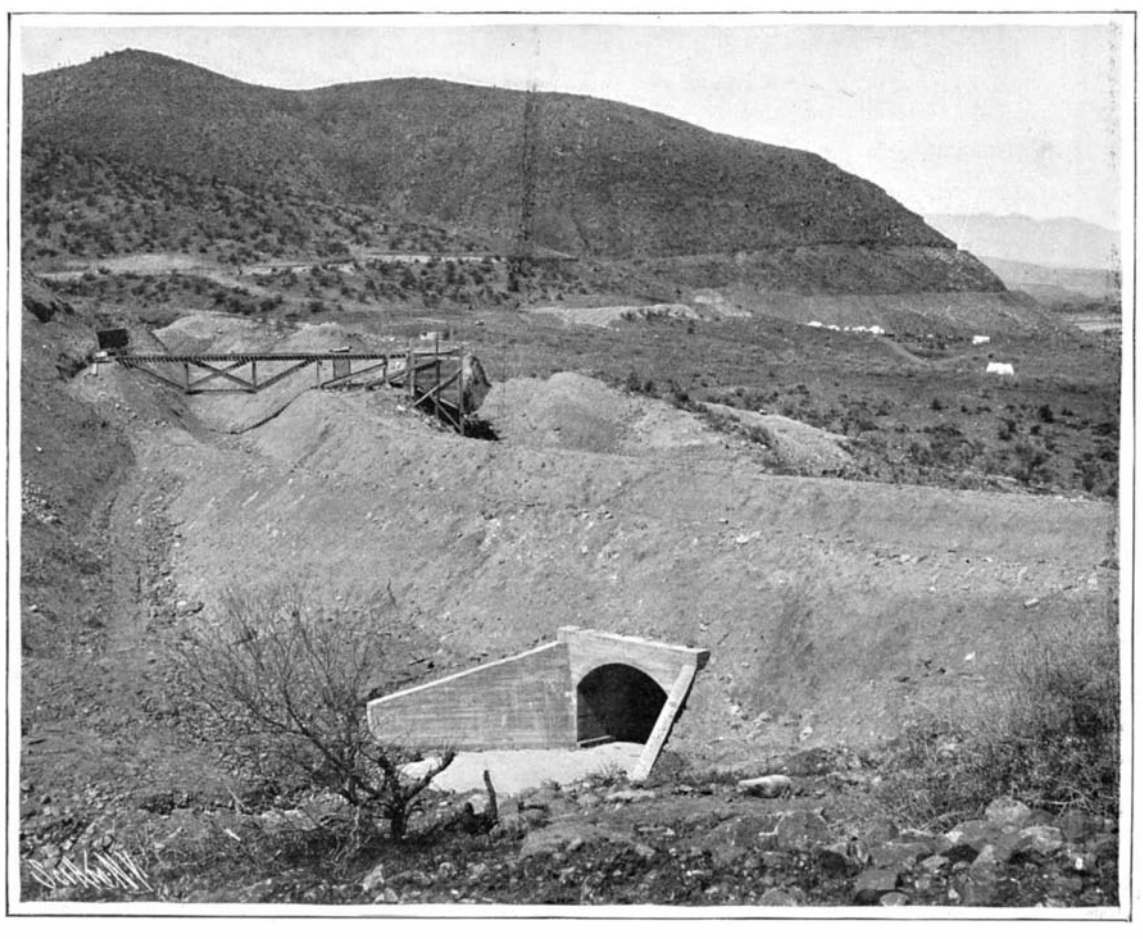
The operations extend into the mountains known as the Sierra Anchas, from which the necessary timber for false work and lumber for the buildings have been secured. Here a large sawmill has been erected. Fortunately a deposit suitable for the base of Portland cement has been discovered, about seven miles from the site of the dam, which is large enough to supply all of the raw material needed. It has been connected with Roosevelt by a tramway. Other auxiliary industries are lime kilns and brick kilns. Thus nearly all of the materials for the dam are being secured or manufactured in its vicinity. Thus far, over $500,000 has been expended in preliminary work, and within the next year it is expected that a considerable portion of the dam itself will be completed.

As already stated, the Salt River basin is now partly reclaimed for cultivation, but the irrigation systems are so inadequate that only about 75,000 acres can be served by the volume of water available during the entire year. The total area which will be reached by the new reservoir ranges between 250,000 acres and 275,000 acres, more than the entire area at present irrigated in the State. Measurements taken of the flow of water in the Tonto River itself, show that it is ample to supply this area without the possibility of failure. The result of the irrigation will undoubtedly be to make this desolate section of the United States one of the most fertile in the world, for the results which have already been obtained in grain growing and fruit and vegetable culture show that only water is needed to produce regular harvests. At present the yield of live stock and alfalfa alone is over $1,500,000 in value annually, from the comparatively small acreage which is cultivated; but fruits and vegetables native to the tropical and temperate zones, as well as corn, wheat, cotton, and other staples grow so abundantly, that in some instances three and four crops are gathered in a year.

On the Berlin-Dresden wireless telegraph line a working periodicity of 900,000 has been adopted. From the station at Oberschönlweide good readable messages have been sent not only to Dresden, 110 miles, but also to the lighthouse station at Fehmern, in Holstein, 166 miles northwest, and Carlscrona, in Sweden, 281 miles north. At Dresden during the night hours signals have been read that originated at the Marconi station at Poldhu, a distance of 764 miles. The wave length of the undulations from the latter station has been determined to be about 2,000 meters, or 1¼ miles.



Concrete-Lined Tunnel on the Power Canal.



Section of the Canal Built to Furnish Power in the Construction of the Roosevelt Dam.

THE GREAT ROOSEVELT IRRIGATION DAM IN ARIZONA.

The Temperature of Subways.

Before the opening of city subway lines employing electric traction, it was supposed that the temperature of the tunnels would be in all respects like that of cellars—not so cold as the exterior in winter, not so warm in summer. The analogy of the two cases seemed to be complete. But this was a delusion, for experience shows us that it is always warmer in the tunnel than at the exterior, even in summer. The causes that create the thermic condition of cellars and subways are well known. The temperature of any point of the earth depends normally upon two factors: the solar heat diffusing itself from the periphery of the earth toward the lower regions of the terrestrial crust, and the central heat of the globe diffusing itself in a contrary direction.

Now, the variations of temperature due to the sun become insensible at quite a slight depth (bordering on 33 feet in the majority of climates) on account of the trifling conductivity of the rocks for heat. At such level the temperature is absolutely constant during the entire year, and the figure that it reaches is exactly the mean temperature of the place. At a lower level the terrestrial strata have a higher temperature due to heating by the central caloric, and we know that the geothermic degree, that is to say, the vertical distance to which it is necessary to descend in order to find an elevation of 1 deg. C., has the mean value of from 98 to 107 feet; but the temperature, here again, is constant for a determinate depth. Thus the cellars of the observatory of Paris, which are 92 feet deep, preserve an absolutely constant temperature of 10.8 deg. C.

As the cellars of our dwellings do not usually descend to 32 feet, they are not entirely protected from the thermic variations due to the sun; yet such variations are attenuated and always occur therein a little later on than those of the surface.

As for the Metropolitan of Paris, the tunnel, contrary to what occurs in our cellars, possesses in summer a temperature greater by three or four degrees than that of the exterior. In the new subway of New York the variation in the same direction is sensibly 6 deg. F., that is to say, 3.3 deg. C.

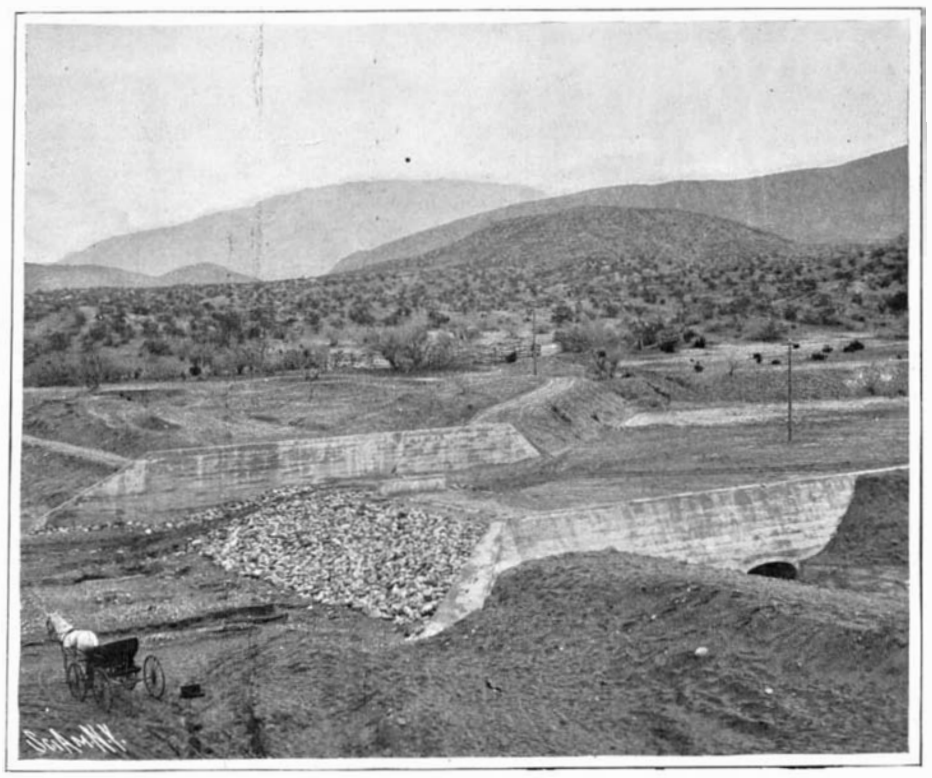
Our contemporary, La Genie Civil, makes the reason of this phenomenon clear. In tunnels there are, in fact, two new introductions of heat—in the first place that disengaged by the respiration of the passengers, and, in the second, that much more considerable one which results from the conversion of all the energies brought into play in the exploitation into calorific energy. These are furnished entirely in the form of electric current for lighting and for traction. A little reflection shows that all, whatever transitory form they may affect, resolve themselves definitely into heat. The radiation of the lamps appears immediately in the form of heat, without any other transformation. The traction current contributes, indeed, to furnish kinetic energy to the train in starting and, in normal running, to maintain the speed despite the passive resistances; but the effect of such resistances is to cause the immediate appearance of a quantity of heat equivalent to the work that they absorb; and finally, at the stoppage of the train, the braking resolves the energy of the motion acquired at the preceding start totally into heat.

If we imagine that the furnaces of the boilers of the central stations of the Paris Metropolitan were utilized not for producing an electric current, but for directly heating the tunnel, by steam pipes or some other process, the result would be nearly analogous to what we now find. Analogous and not identical, however, for it would be necessary to take into account the rendering of the boilers, of the steam motors, of the dynamos, and of the entire electric wiring external to the tunnel. In fact, the heat of the furnaces would reappear in part in many other places besides the tunnel. However, the calculation of the heat produced in the Metropolitan is easy. It suffices to know the number of kilowatts introduced into the tunnel.

It is the ventilation almost solely that intervenes to dissipate these introductions of heat, for at the end of a few months the walls of the Metropolitan took on the temperature of the air and, since their conductivity is but slight, they contributed but little toward the cooling. The air enters and makes its exit through the station doors and the open sections. The violent currents of air which prevail at the entrances are a proof that the ventilation is extremely active in the Metropolitan of Paris. For the New York subway, a calculation has been made of the volume of external air that must circulate daily in order that the variation in temperature shall remain within the indicated limits of 6 deg. F. Estimating the losses of heat by conduction as 10 per cent, it is found that all the air of the tunnel is renewed about two hundred times in twenty-four hours.

The running of the trains does not intervene profitably in the ventilation of double-track tunnels. The trains create solely violent and purely local vortices, of which the action is no longer felt at a few score feet in the rear.

As natural ventilation is inadequate in summer, it is necessary to install a forced one, if it is desired to render the atmosphere of subways supportable during hot weather. The question is under study for the New York subway, where it is proposed to install powerful electric fans. But it is necessary to resign ourselves to the fact that although an infinite volume of air should be supplied, the passengers in subways will never enjoy an agreeable coolness in summer, since the temperature of the tunnel cannot descend below that of the exterior.—Translated from Cosmos for the SCIENTIFIC AMERICAN.

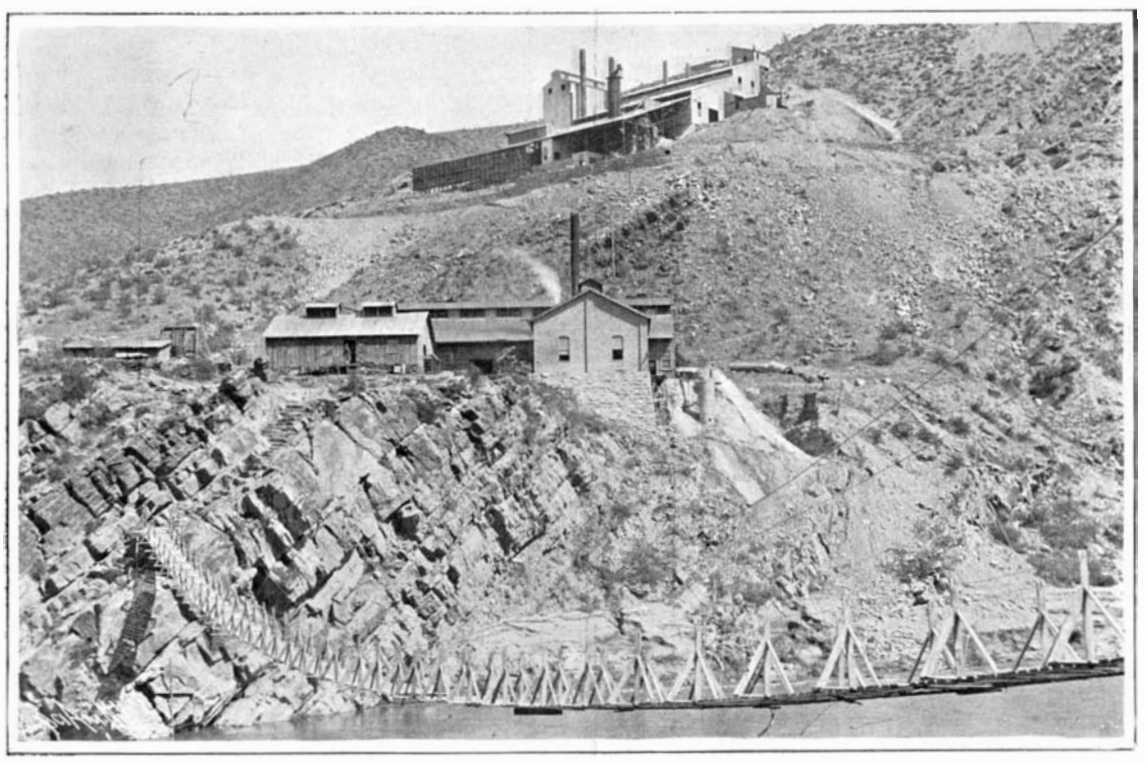


Concrete Culvert for Carrying the Power Canal Below a Mountain Stream.

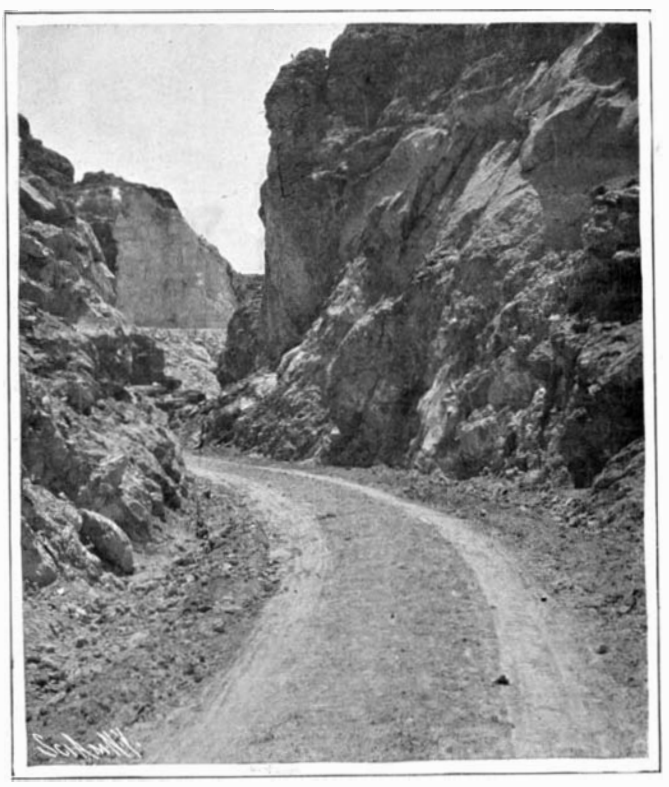
Paper Gas Pipes.

Paper gas pipes are among the novelties to be reported from Europe. It appears that paper can be used to advantage for this purpose. As to the method of manufacturing the pipes, Manila paper is cut up into strips whose width is equal to the length of the pipe section to be used. The paper bands are then passed into a vessel filled with melted asphalt. After coming out of the bath the prepared strip is rolled uniformly and very tightly around an iron rod or pipe which serves as the core and has the same diameter which the gas pipe is to have. The rolling of the paper is stopped when the right thickness has been secured. After the pipe section which is thus formed has been put through a high pressure it is covered on the outside by a layer of sand which is pressed into the asphalt while still hot. Then the whole is cooled off by placing it in water. The core is taken out and the outer surface of the pipe is treated with a waterproof compound. It is said that the pipe is very tight and is cheaper than metal piping.

The establishment of the silk industry in the United States must be a matter of slow accomplishment. Eventually enough mulberry trees will be planted to insure a supply of food for a large crop of worms. Numbers of people have become familiar with the methods of silk raising, and conditions will soon be ripe for the establishment of commercial filatures. In the meantime and under the existing conditions the establishment of some sort of market for cocoons is necessary; and it is for this reason that the Department of Agriculture, out of its appropriations, is buying and reeling a crop of cocoons which, though small at present, will increase as the work progresses from year to year.



One of the Concrete-Mixing Plants Built Near the Site of the Dam.



Heavy Cutting on Construction Road, Built by the Canal Engineers.

THE GREAT ROOSEVELT IRRIGATION DAM IN ARIZONA.

RARE SHELLFISH.

BY ARTHUR INKERSLEY.

Though the flesh of the abalone is a nutritious and wholesome article of food, highly esteemed by the Chinese and Japanese, few people in the United States know anything about the abalone, except that it has a large shell with a bright, pearly interior. The abalone is a gigantic sea-snail, whose natural home is the deep water off a rocky coast. The whole coast of central and lower California, from Cape Mendocino to Cape St. Lucas, abounds in abalones, the supply being absolutely unlimited. As fast as an area of fishing ground is depleted it is repeopled by full-grown abalones coming in from the ocean. Three months after a piece of ground has been thoroughly cleared by the abalone fishers, the supply is as abundant as ever.

The contents of a large abalone shell weigh as much as two pounds, and the value of the meat as a wholesome and digestible food was long ago discovered by the Chinese and Japanese. The supply of abalones in Chinese waters is, however, small, and the fishing grounds off the coasts of Japan were so heavily drawn upon that they became exhausted. The people are forbidden by an imperial edict from taking them. The Japanese and Chinese in California dive for the abalones, which crawl about the rocks at the bottom of the sea in deep water outside the surf. The divers bring them ashore, and spread them out in a sunny place to dry. The drying process reduces the abalone to about one-third of its original bulk, leaving a tough, horny product. The dried abalones are sent to the Orient, where they are soaked and stewed, or ground into powder and used for making soup. The Japanese have improved this primitive method of treating the abalone. They cut the flesh from the shell while the creature is still alive, boil it, and can it in the same manner as clams or oysters. But even this method, though quicker and better than the sun-drying process, is crude and yields a tough product.

A few years ago some Americans, whose attention had been drawn to the large quantities of dried abalone exported to China and Japan, attempted to discover a process whereby the flesh of the abalone could be rendered soft and palatable. The abalone lives in the pure, deep waters of the ocean, and is a clean feeder, so that its flesh is always sound and wholesome, being superior in this respect to that of oysters and clams, which live near shore and are often contaminated by sewage and other impurities. The viscera, or entrails, of an abalone, unlike those of the clam or oyster, which must be swallowed whole, are quite separate from the muscular or edible part, and can be detached by a single stroke of a knife. The flesh, however, when simply boiled, no matter for what length of time, becomes hard and horny. After many experiments, a San Franciscan named J. W. Gayetty discovered a process whereby the flesh of the abalone is rendered soft and succulent like that of an oyster. He is now the president of a company operating a cannery fully equipped with every requisite for the preparation of abalones as food. The cannery is situated at Cayucos, in San Luis Obispo County, California.

For the purpose of gathering the abalones there is a large number of roomy, seaworthy boats, each of which carries two Japanese divers, one of whom goes down for three or four hours and is then relieved by the other. The diver tears the abalones, with the moss and seaweed attached to them, from the rocks on which they live, sending up the shells in baskets as rapidly as possible. Under ordinarily favorable conditions, a diver can send up to the surface a ton of abalones in an hour. As soon as the boat reaches land, the abalones, if not wanted at once, are thrown into a big tank of salt water, the bottom of which is made to resemble the floor of the ocean as much as possible. There they are kept until wanted at the cannery.

The flesh and juice of the abalone are treated together, the resulting product having a flavor more delicate than that of the oyster. It can be fried, stewed, or used in fritters, while the juice makes an excellent soup or a good appetizer. Though the flesh and juice are the most important portions, no part of the abalone is wasted. The viscera, or entrails, yield glue of a high quality, and the shells are a valuable commercial product. The pearl button trade depends largely on the nacreous material on the inside of the shell, from which cuff buttons, knife handles, inkstands, paper cutters, candlesticks, and curios are manufactured. The shells are used for these purposes on the Pacific and Atlantic coasts, and are also exported to Europe, their value being from $35 to $135 per ton, according to quality. Sometimes pearls are found in abalone shells, and for these a premium is paid to the men. A great quantity of canned abalone is sent to China and Japan, where it is a favorite article of food. Dried abalones fetch from 11 to 15 cents per pound. The leading hotels and restaurants of San Francisco now have abalone chowder as a regular item of their bills of fare.

DRYING ABALONES FOR SHIPMENT TO THE ORIENT.

The rock oyster is found only on the coasts of Spain and of Oregon. At Yaquina Bay, a favorite summer resort of Oregonians, digging rock oysters is a regular pastime. In the early morning, before the sun is high, crowds armed with picks and shovels wend their way to the famous rock-oyster beds. Prof. Condon, the State Geologist of Oregon, says of the rock oyster:

"Its scientific name is Pholas. Like all bivalves, it has right and left valves, each having on its middle portion a triangular, rasp-like valve. It is this rasp-like organ that enables it to excavate and keep its burrow open. The rasp is not hard enough of itself to cut the rock, but the hard quartz sand that rests in the folds of the rasp gradually wears away the stone as fast as needed, corresponding with the growth of the oyster. When the eggs are hatched in the seawater, they look like small patches of jellyfish, and for several days swim about with the outlines of their future shells forming slowly about them. By instinct each looks for a vacant spot on a rock-surface, and when found he backs against it and goes into business. They are preferred to all other bivalves for the table, and, as they are found only in one place on the coast of Spain and at Yaquina, they are an unparalleled attraction."

DIGGING FOR ROCK OYSTERS AT YAQUINA BAY, OREGON.

The cruiser "Galveston," on her trial trip, maintained an average speed of 16.56 knots for four hours.

Mining in the Grand Canyon.

BY ALLEN DAY.

The Grand Canyon of the Colorado is so closely associated with the barren country of the Southwest that its possession of valuable mineral resources is comparatively unknown. As a matter of fact, however, the erosion which has been continuing for centuries on such an enormous scale has brought to the surface indications of metal which are familiar to merely the few prospectors who have explored the Canyon. The most notable deposit of this kind thus far discovered is copper ore. A mine is now in operation on what is known as the Grand View trail, which is undoubtedly one of the richest in the world. The existence of the deposit was known over ten years ago, and at one time the famous Buck O'Neil owned the claim. Little work in the way of development was undertaken until recently, when an organization known as the Canyon Copper Company exploited it on a scientific basis, with the result that ore was found which actually assays 75 per cent carbonate, being largely of the malachite variety.

The mine is situated in a formation over a thousand feet below the rim and in one of the buttes or pillars in proximity to the southern side of the Canyon. It is found in porphyritic rock and is what geologists might term a thrust. The ore lies in such a position that it can be readily reached by lateral openings, and an opportunity has been given to make a very thorough examination. So extensive is the deposit that in places the width is no less than 500 feet. It is found in quite a variety of forms, largely in sulphates, although grains of pure copper are frequently secured in mining.

As yet the ore is extracted almost entirely by hand labor, and while enough of it has been taken to the smelter to determine its commercial value, the bulk of it has thus far been placed in the stock pile. Owing to the location of the mine the modern method of transportation as yet has not been employed, and that followed in South America and Mexico and some other countries is in vogue—packing the ore intended for the smelter to the rim on the backs of burros. As may be imagined, this is a very expensive process, but the richness of the ore is such that it can be procured in this manner, transported to the nearest railway which is fourteen miles distant and hauled by rail to the city of El Paso—615 miles—and the large profit realized from the metal obtained. The plans of the company contemplate the construction of an aerial tramway or telpherage system, as a source of electric power is available from a water-course which flows through one of the branch canyons into the Colorado. The volume of water and descent of the river itself near Grand View are so great that ample power could be secured, but the rise in flood time in the Colorado is so rapid and of such dimensions that it is questionable if a dam could be built which could withstand the enormous pressure.

The Canyon Copper Company is composed of capitalists from New England and from the town of Flagstaff, Arizona. The miners it employs are Americans. It is an interesting fact that they are practically the only human beings who permanently reside in the Grand Canyon, their settlement being located near the entrance of the mine on a plateau above the gorge through which the river flows. Old miners who have examined the formation between Grand View and what is known as Bass's Camp believe that very extensive deposits of copper ore exist, but with the exception of the Grand View mine no examinations have been made upon a comprehensive scale. On the north side of the river nearly at the foot of the Grand View trail a deposit of asbestos has been found which contains a high grade of this substance. This deposit is controlled by a New York syndicate and preparations are being made to obtain it. The principal difficulty in getting it out, however, lies in the method of transportation, as it will be necessary to build a cableway across the river, since it would be quite impossible to bridge the Colorado at this point and the current is so rapid that the use of boats is almost out of the question.

RETROSPECT OF THE YEAR 1905.

(*Continued from page 475.*)

the perils of fog and thick weather. Other interesting and valuable developments that may be mentioned are the use of the gyroscope to prevent excessive rolling, and also its application as a check upon the mariner's compass; and the successful introduction of an electric dead reckoner by which the course, distance sailed, and speed of a ship are automatically drawn upon a chart.

THE TURBINE AND THE PRODUCER-GAS ENGINE.

A review of progress in the merchant marine naturally leads us to a consideration of the steam turbine, and its coming rival the producer-gas engine; for although the steam turbine received its first practical application in an electric lighting plant, its prominent introduction to the world was made in that phenomenal little steam yacht the "Turbinia." By the close of the year three vessels will be in the transatlantic service whose successful operation will have set at rest all question as to the availability of the turbine as a drive for ships of the largest class. The "Victorian" and the "Virginian" of the Allan line, each of which is 530 feet in length, are driven by turbines of 10,000 horse-power. The first-named made 19, and the second vessel 19½ knots on the trial trip, and they have broken all existing records over their own transatlantic route. The "Carmania," whose turbines are of over 21,000 horse-power, has made 20.4 knots on trial. There was trouble during the early voyages of the "Victorian;" but both of the Allan line ships are now giving excellent service. The 3,000-ton turbine-propelled ship "Loongana" gave a further demonstration of the reliability of the turbine in the course of a thirty-and-a-half day trip from Glasgow to Australia, when an average speed of 15 knots an hour was maintained throughout. This is the longest journey ever made by a turbine-propelled vessel. In the smaller classes of vessels, such as those used for river and cross channel service, the turbine has scored a signal triumph over the reciprocating engine. A comparison of the "King Edward" with a vessel similar in every respect except that of motive power, showed that while during eighty days of sailing at an average speed of 18½ knots, the steamer with reciprocating engines consumed 1,909 tons in steaming 12,106 knots, the "King Edward" with turbine engines consumed only 1,429 tons in steaming 12,116 knots. Another absolutely reliable basis of comparison has been afforded by the four new Isle of Man passenger boats, two of which have turbine, and the other two reciprocating, engines. The turbine steamer "Manxman" in the comparative trials steamed 20.3 knots on the same amount of fuel as was consumed by the reciprocating engine steamer "Antrim" when making 19.5 knots. Five gallons of lubricating oil was saved on each 60-mile trip, and the staff of oilers was reduced from four to two. There was a saving of weight in the turbine engines of 115 tons, or 6 per cent of the total weight of the ship.. Regarding the development of the steam turbine for stationary service, it is sufficient to say that the excellent results achieved in steamship service have been repeated in the great electric light and power plants on shore. For reasons which we cannot now go into, the stationary turbine has not shown the same superior economy as the marine turbine over the reciprocating engine; but the advantages in small space occupied, small amount of lubrication, and smaller staff required have been decisive.

An event which in importance is probably destined to rank with the advent of the turbine steamer "Turbinia" was the appearance during the year of a successful steamship driven by a producer-gas engine. The system was devised by Herr Emil Capitaine. This little vessel, named after the inventor, is 60 feet in length, and is driven by its producer-gas engine at a speed of 13 miles an hour. During a ten hours' run at 13 knots speed, only 467 pounds of anthracite were consumed at a cost of $1.08. Following the producer-gas steamer we may look to see a producer-gas locomotive—this last an entirely feasible proposition. The claim of the producer-gas engine makers that a properly constructed plant will run on less than a pound of coal per horse-power per hour has recently been vindicated in a series of tests carried on by the Highland and Agricultural Society, in Great Britain, when ten complete plants were submitted for approval. Trials were made of plants of 20 and others of 8 horse-power capacity. The coal in pounds per brake horse-power per hour consumed by four 20-horse-power plants was respectively 0.93, 0.77, 0.80, and 0.83, and in four plants of 8 horse-power it was respectively 1.22, 1.13, 0.84, and 1.35, all of these being full-load trials. Regarding the prospects of the production of a successful gas turbine not much can be said; for the matter has not, as yet, progressed far beyond the experimental stage.

THE AUTOMOBILE.

Let us hope that the parallelism between the astonishing development of the bicycle and the automobile will not hold good as regards the rapid decline of the bicycle in popularity. The fifth annual Automobile Show, held early in the year, was a splendid tribute to the development of the art of automobile construction in this country, and the very reliable service now given by the best American makes proves that we are, at last, within reach of that long-anticipated stage when the automobile enthusiast will no longer have to go abroad to secure the very best machines. If we except the racing machines, pure and simple, and the touring automobiles of the highest power, it may be said that automobiles are grouping themselves broadly under two distinct types: One, the moderate-powered and moderate-priced runabout of from 8 to 16 horse-power, and the other, the standard touring car of from 24 to 36 horse-power. It is claimed by the advocates of the last-named type that 24 to 36 horse-power is sufficient for all the ordinary exigencies of touring, and for all legitimate speeds. Contrary to expectation, there is no tendency as yet to an all-round reduction of price. Rather the tendency is to offer a better machine and to charge more for it. Mechanically, the development during the year has been upon well proved lines, and radical novelties have been conspicuous by their absence. The great international races of the year were run off successfully and without serious accident—indeed, it is noticeable that accidents in racing are decreasing in the ratio in which fatalities on the road are on the increase, for the list of automobile fatalities and casualties is growing to enormous and positively tragic proportions. The Gordon-Bennett trophy was won this year by a Richard-Brazier car driven by Leon Théry, the 341.4 miles of the course being covered at an average speed of 47½ miles an hour. The second contest for the Vanderbilt International Cup was held over the Long Island course under most favorable conditions. Although the race was won by the Frenchman Hemery on an 80-horse-power Darracq, at an average speed of 61.49 miles per hour, the sensation of the race was afforded by the Italian driver Lancia in his 110-horse-power Fiat machine, who, starting fourth, took first place at the end of the first round, and held it for seven rounds until an accident threw him temporarily out of the race. During this first 200 miles his average speed was within a fraction of 70 miles an hour, and his fastest lap of 28.3 miles was run at a speed of 72.88 miles per hour. There is a disposition on the part of the European manufacturers to discourage the perpetuation of these great road races; but their novelty and great popularity in America insure their perpetuation for at least some years to come. The annual races on the beach at Florida resulted in several world's records coming to America. Mr. Bowden in a 120-horse-power Mercedes racer of overweight, covered the mile straight-away in 32 4-5 seconds, while McDonald on a 90-horse-power Napier cut down last year's record of 6 minutes and 50 seconds for the 10 miles to 6 minutes and 15 seconds, an average speed of 96 miles an hour. A healthy sign is the increasing popularity of competitive tours to determine the relative reliability and economy of the competing cars. Chief among these during the year was the contest of touring cars for the Glidden trophy which was run off over a course from New York to the White Mountains and return, and was won by a 28 to 32 horse-power, four-cylinder Peerless car, and the six-day economy test held last month, which was won by a Reo bus carrying ten people. The total cost of running the winner for a distance of 682 miles was found to work out at the low cost of only $2.93 for each of the ten passengers carried.

AERIAL NAVIGATION.

In a resurvey of the progress of aerial navigation during the past year, we draw attention to the encouraging and significant fact that effort is being directed increasingly to the development of the aeroplane as distinguished from the balloon-supported type of airship. The SCIENTIFIC AMERICAN has always claimed that, because of the inexorable limitations put upon the navigable balloon by the enormous atmospheric resistance encountered by the gas bag, a resistance which increases as something more than the square of velocity, we must look to the perfected aeroplane for the solution of the problem of mechanical flight; or, rather shall we say, of mechanical flight that will be of practical and commercial value. At the same time, the fact remains that the only successful "flying" that has been done this year, as in previous years, is to be credited to the balloon type. Young Knabenshue, Baldwin's former assistant, has built an airship very much on the lines of the Baldwin machine, with which he has given successful exhibitions throughout the States, none of which brought him more widespread recognition than his successful flights over predetermined courses above Manhattan Island. Santos-Dumont is out with a new machine "No. 14;" but, apparently, he has made no public demonstrations with it. The Barton airship, a huge structure, 180 feet in length by 40 feet diameter, made a trial trip on July 22, when the vessel ascended with five aeronauts. A thirty-mile wind was blowing, against which the ship was just able to hold its own. The vessel showed that it was controllable; but the performance was scarcely commensurate with the great size and power of the machine. Among the many aeroplane experiments recorded during the year are that of Archdeacon which was a failure; and the two attempted flights of Montgomery, the first of which was successful, and the second of which, because of the collapse of the machine, cost the aeronaut his life. The Alvares aeroplane, which is modeled after the outspread wings of a bird when in flight, was given a fairly successful test, but not under full-sized working conditions, nor with any operator on board. The Gillespie aeroplane, which is supposed to be driven over the earth on its carrying wheels until it reaches a velocity at which it will rise into the air, has been designed with a view to absolutely preventing the "diving" propensities which have proved so fatal in previous machines. Some extremely interesting and fairly successful experiments have been made in which the actual wings of birds, or aeroplanes built up of birds' feathers, have been employed, some of the built-up wings being as much as 12 feet in length. The Ludlow aeroplane experiments in this city have attracted considerable attention, and one successful flight was achieved. One of the most important balloon achievements of recent years was the winning of the long-distance balloon race from Liege to Julich in the Rhenish provinces. The English balloon, "Vivian III.," which won the race, made most of the journey at a height of 16,000 feet above the earth, and in a wind that was frequently blowing at 50 miles an hour. The future of aerial navigation, as we have said, is bound up with the success of the aeroplane, and the most promising results to date were those obtained last year by the Wright brothers, one of whom made a flight of over half a mile in a power-propelled machine. It is gratifying to know that during the present year they have been carrying on their investigations.

Correspondence.

Teaching Science.

To the Editor of the SCIENTIFIC AMERICAN:

May I take a little more of your space to say a few words in reply to Mr. Andrews's letter in your issue of November 18? Some of Mr. Andrews's points are excellently taken, and I heartily agree with his main contention, that one should not exact too much of schoolboys. But if he will reread my letter, he will notice that at Trinity College, the candidates for admission are not expected to offer Physics, though they may attempt to pass off Physics I., and they can hardly expect to be asked questions easier than those the freshmen have to pass on. This plan of allowing students to pass off the first college course through their knowledge obtained in school is by no means confined to Trinity, and wherever this is the case, they must be measured by college standards. If this standard is too high, then why do the schools allow their graduates to attempt the impossible?

But I will go still further than that in reasserting the claims, based on the entrance papers that have come under my notice, that even the really elementary aspect of the subject is taught unsatisfactorily in many schools.

The fundamental principles are ignored or lost in a maze of confusing and mechanically followed experiments, and what should be a splendid background for the more mature treatment of physics as pursued in college, has only resulted in confusing and incapacitating the student. I do not claim that this is universal, but much too frequent; and in my own experience I find (except in a few shining exceptions) very little difference between the pupil who had physics before and the one who is grappling with the subject for the first time; and sometimes even the latter is the better student, because he is not tempted to count on the rather hazy recollections of his school course.

If then Physics is to be taught in schools, let it be clearly understood whether the aim is to give the equivalent of the first college course, or whether it is to be a really primary treatment. In the former case it should certainly be taught as in college, and I think that is possible with pupils over sixteen years of age. Otherwise let it be a real foundation for more advanced work, and not a mere kindergarten based on physics.

Whether this foundation course should be recognized in the entrance examinations of a college, or not, is another question, which I do not propose to discuss here.

I heartily indorse Mr. Andrews's view that a physics teacher requires more constant training than a teacher in many other branches, and that it is necessarily harder to find good ones. But I am still convinced that too much laboratory, and too few problems and explanations, account for much of the inefficiency in school teaching. The inductive method is absurd in an elementary course, but that is too large a subject to go into here.

HENRY A. PERKINS.

Trinity College, Jarvis Physical Laboratory, Hartford, Conn., November 24, 1905.

A TYPICAL AMERICAN TOURING CAR.

The annexed sectional cut shows in considerable detail the mechanism of a gasoline touring car of distinctively American type. From the manufacture of a single-cylinder runabout and light tonneau, the makers of the Cadillac machines have risen to the construction of the huge car seen below. In doing this, however, they have wisely retained features which contributed largely to the success of the smaller models, and at the same time added several novel improvements. Thus we see on the touring car engine copper water jackets, variable-lift mechanically-operated inlet valves, and the same floatless atomizer or mixer that have been used heretofore; while a distinct novelty for a car of this kind is the employment of a planetary transmission gear which, in connection with a clutch in the flywheel, gives three speeds forward with a direct through drive on the third, or high speed. The special form of three-speed planetary gear for the large touring car was developed from the two-speed gear of the smaller machines by the addition of only one moving part. As is well known, this transmission is well adapted for continuous heavy pulling, because it has no high-speed parts and its gears are subjected to lower tooth strains, size for size, than those of any other common type of transmission. With this type of transmission it is possible to pass instantly from one speed to another by simply pushing a lever. The telescopic universal joint, 59, is to be noted. The car has a spur-gear differential and bevel driving pinion, 61, which can be readily adjusted from the outside. The main rear axle is a solid tube having ball bearings on each end for the wheels. The live axle extends through these, and drives them by means of jaw clutches that lock it to the outside face of the hubs. The car has long, heavy springs, besides a transverse spring at the back. Its wheels are shod with 34 x 4½-inch tires, and it has a wheel base of 100 inches, while the length of the frame itself is over 12 feet. The weight complete is in the neighborhood of 2,600 pounds. The 4⅜ x 5-inch engine is rated at 30 horse-power, and it is capable of driving the machine at a rate of speed of 50 miles an hour.

Altogether this car is a good example of that simplicity of construction that is aimed at by almost all American builders.

A Novel System of Wireless Telegraphy.

BY DR. ALFRED GRADENWITZ.

Our readers will doubtless remember the beautiful experiments in wireless telephony which were made by Herr F. Ruhmer on the Wannsee Lake, near Berlin, last year and continued with increasing success in the course of last summer. Now the inventor has applied his process to optical telegraphy.

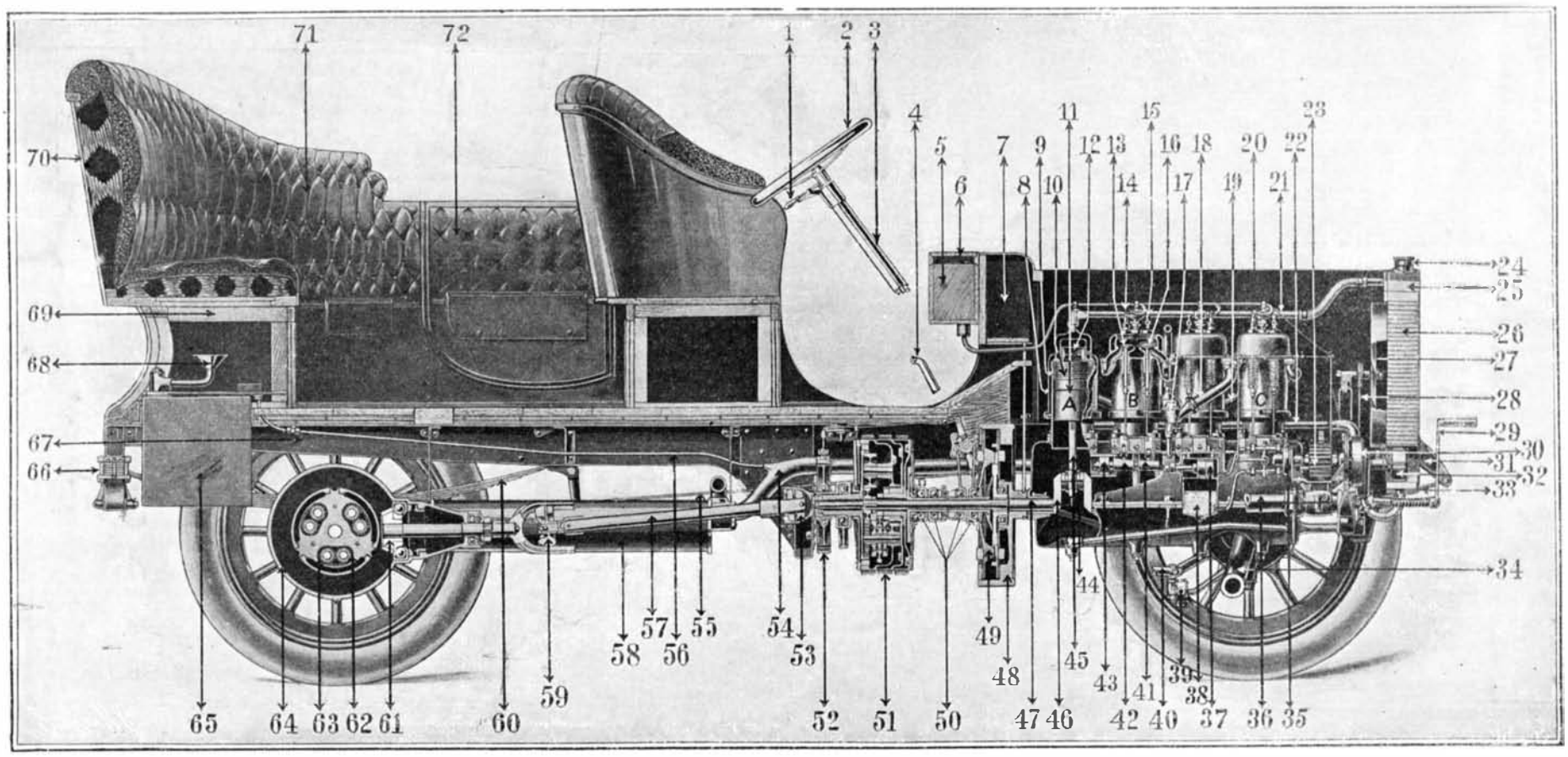
In optical telegraphy the rays issuing from a projector are, as a rule, intercepted at given intervals, so as to form luminous flashes, succeeding one another more or less rapidly. In the Ruhmer telegraph system, on the contrary, the so-called speaking arcs are utilized by superposing on the direct current circuit of the lamp placed at the sending station in the focus of a projector, a continuous current frequently broken by means of a mechanical interrupter, the opening and closing being insured by a Morse key, in accordance with ordinary Morse signals. At each closing of the telegraph key, the superposed and frequently interrupted current will modify the luminous intensity emanating from the electric arc, giving rise to luminous oscillations which are projected toward the receiving station. If all the conditions be so arranged that the luminous intensity of the lamp is maintained constant, this process will insure not only a more rapid handling of telegrams, but will permit at the same time of keeping the latter strictly secret, as the human eye, incapable of discerning any more than 10 luminous alternations per second, will get the impression of a continuous beam on account of the rapidity with which the luminous oscillations of the transmitting station will succeed each other.

The receiving station is arranged in a way analogous to those of optical telephony, comprising two telephones and one parabolic reflector in the focus of which the selenium cell is placed. The luminous oscillations of the transmitting station act on the selenium cell at the receiving station to alter the resistance of the electric circuit through the telephones, thereby producing intermittent humming sounds which vary with intervals corresponding to those of Morse signals. The pitch of this sound will depend on the frequency of the interrupter. Whereas in transmitting language, uncertainties are possible on account of the different acoustical intensities of the different vowels, the same sounds have to be heard here for more or less prolonged intervals. It has therefore been possible to insure perfectly clear transmissions of signals in atmospheric conditions which would have rendered difficult the transmission of language. The beginning of a communication is indicated by a bell, operated by the selenium cell without the agency of any wire connecting it with the transmitting station.

The satisfactory results of the experiments so far made, go to show that this system of optical telegraphy, like the analogous system of optical telephony, will be used to special advantage in the case of transmissions over short distances.

A Prize for Cement Essays.

Prizes to the value of 15,000 marks are being offered conjointly by the Prussian government and the German Society of Portland Cement Manufacturers for essays on the processes which take place during the hardening of hydraulic cements. The following questions are those offered for investigation, any or all of which may be taken by the competitor: Demonstration of the properties and of the hardening process of calcareous hydraulic cements, synthetically, analytically, microsopically, mineralogically (hardening in air, fresh water, and sea water). (a) To prove whether silicic acid, alumina, and oxide of iron combine with lime as crystalloids in stable proportions, or as colloids in varying proportions. (b) To prove whether double combinations result between silicic acid, alumina, and oxide of iron with lime, and in what manner these substances are engaged in the hardening process. (c) Consideration of the swelling phenomenon which accompanies the hydraulic hardening. (d) Consideration of the influence of the temperature and length of time of the burning process on the different kinds of hydraulic cements. (e) Properties of puzzolana and its hardening with lime; beginning with silicic acid as the most active and prevailing puzzolana, alumina, oxide of iron, and manganese, independently and in combination with silicic acid, either as natural or artificial puzzolana. The papers must be written in German and submitted under a *nom de plume* to the Ministry of Public Works, 80, Wilhelmstrasse, Berlin, on or before December 31, 1906. The papers will be adjudicated by a committee comprising Profs. Van't Hoff, Schiebe, and Fresenius, Drs. Michaelis and H. Passow, and Messrs. E. Crammer and F. Schott, and officials of the Royal Testing Station, Berlin.



LONGITUDINAL SECTIONAL VIEW OF A FOUR-CYLINDER GASOLINE TOURING CAR OF DISTINCTIVELY AMERICAN DESIGN.

1, Throttle lever; 2, steering wheel; 3, steering column; 4, clutch and brake pedal; 5, spark coil: 6, vibrator; 7, 5-gallon gasoline tank for supplying carbureter by gravity; 8, copper water jacket; 9, cylinder wall; 10, piston rings; 11, piston and oil groove; 12, compression chamber; 13, inlet valve; 14, spark plug; 15, relief cock; 16, exhaust valve; 17, carbureter; 18, inlet pipe; 19, exhaust pipe; 20, bonnet; 21, 22, water pipes; 23, gear for driving oil pump; 24, radiator cap; 25, water tank; 26, radiator; 27, radiator fan; 28, chain for driving fan; 29, starting crank; 30, centrifugal water pump; 31, spring hanger; 32, commutator; 33, front spring; 34, tubular axle; 35, oil pump for governing device; 36, tubular sub-frame supporting engine; 37, piston of oil governor; 38, reserve oil chamber of governor; 39, rod connecting steering levers of front wheels; 40, connection to steering column; 41, exhaust valve cam; 42, variable inlet valve cam; 43, bearing for slidable cam shaft; 44, 45, connecting rod and crank; 46, crank cheek; 47, crankshaft; 48, flywheel; 49, double-faced expanding clutch in flywheel; 50, ball bearings of transmission shaft; 51, planetary transmission giving three speeds ahead and one reverse; 52, double-acting transmission brake; 53, universal joint of driving shaft; 54, exhaust pipe; 55, brake rod; 56, pressure pipe from exhaust pipe to gasoline tank; 57, universally-jointed driving shaft; 58, muffler; 59, slidable universal joint; 60, rear spring; 61, bevel driving pinion; 62, 63, pinions of spur gear differential; 64, differential gear casing; 65, 20-gallon gasoline tank; 66, transverse rear spring support; 67, pressed steel side frame; 68, swinging filler for gasoline tank; 69, wood frame of body; 70, aluminium body; 71, tonneau; 72, side entrance door.

gears are always in mesh, and there is no chance of stripping them from bad manipulation.

The engine is governed by varying the lift of the inlet valves. This is accomplished by sliding the camshaft (the inlet-valve cams of which are tapered) bodily lengthwise and thus bringing the lower part of the inlet cam, 42, beneath the roller of the inlet-valve stem, 13. The result is the valve does not open so much and the engine is throttled. The camshaft is slid by means of a piston, 37, moved in a cylinder by oil pumped by a rotary gear pump, 35. The camshaft is set for maximum lift normally, and held in this position by a spring. When a by-pass controlled by the throttle lever, 1, is opened, oil is drawn from the reservoir, 38, and pumped against the oil piston, thus forcing it, its rod, and the camshaft as well lengthwise against the spring. This is a simple device, which has been found to work well in practice. The lubrication of the engine is entirely by splash, only one sight-feed, supplied by a mechanical oiler, being used. A series of inclined troughs on the inside walls of the crankcase carry the oil from one end of the motor to the other and back, while curved oil pipes on each crank box pick up oil and conduct it to the bearings. The commutator is placed in a hole at the base of the radiator. The jump-spark system with coils having vibrators and with batteries as a current source, is used. A gear-driven centrifugal pump circulates the water. Ball bearings are used throughout, and a special form of

NATURAL AND ARTIFICIAL FLIGHT.

BY E. WILSON.

The present writer's experience in experiments with aeroplanes has demonstrated to his satisfaction that glides with fixed passive surfaces of sufficient area (175 square feet) according to Lilienthal, Pilcher, and Chamber's dimensions, are an admirable means of courting sudden death. Aeroplane fixed surfaces present such an enormous "sail area," and the wind is so notoriously capricious, that to endeavor to reduce flight to perfection, as in the eagle, condor, albatross, and other "gliders," is to attempt the impossible. Why? For the simple reason that we are attempting an advanced stage of progress before we have attained elementary flight, i. e., initial extended flights at will. As a forcible illustration of the vagaries and force of the wind, the writer recently, at the top of the Watkin tower, Wembly Park, 160 feet high, in carrying an artificial wing ten feet long by four feet wide, was thrown sprawling on the platform by an unexpected gust.

Shall man ever reproduce, by his method, "the way of an eagle in the air"? Decidedly, provided he departs from his present tendency toward the aeroplane, and constructs his dynamic aerial ship more on practical lines and in accordance with natural laws as embodied in the bird, bat, and insect. Artificial flight resolves itself into reproducing Nature and her principles by man's method and ingenuity. We have abundant testimony by Pettigrew's researches that the artificially-constructed wing becomes in action a powerful propeller, sustainer, and aeroplane, increasing in efficiency with the speed at which it is driven. Screws, moreover, opposing a slanting plane, will create an ascensive movement, or horizontally, will increase the disposable weight apart from the motor and apparatus proportionately as speed increases, but will not retard descent, as in the artificial wing. Herein the wing has an inherent advantage, theoretically, over the screw, but the writer considers in practice the screw far more practical, basing this remark on his own experiments with full-sized apparatus.

Nothing is better established than that theory and practice will not agree in aerial experimentation when we come to test our apparatus. Such is the erratic behavior of the wind that it entirely upsets our calculations, besides our machines. In Fig. 1 two Pettigrew type of wings are shown (somewhat hastily put together for photographing only), to test their efficiency when actually in the air. The results were extremely disappointing, the apparatus in many trial flights, and reducing and adjustment of weights, refusing to "glide," even at its earliest trials before they began to show signs of considerable usage. Attempts were made with and against the wind, with the apparatus held perfectly horizontal (Fig. 2), but though the height of the specially erected staging is 60 feet, results, and poor results at that, could be obtained only by increasing the surface which, for flapping flight, of course, was inadmissible. The weight of the second model, Fig. 2, was approximately 250 pounds, with aeronaut and contemplated motor of 6 horse-power, being 22 feet tip to tip, with a "tail" five feet long and three feet across. In beating the air the anterior margin of the wings, being heavier and semi-rigid, created a tendency to pitch the machine forward and downward; indeed, it was recognized by the writer that the Pettigrew form of wing, as advocated, although suitable for laboratory experiments, is quite unsuitable for full-sized apparatus in the air itself, the power transferred to the front edge being wrongly applied. The last experiment with this type of wing is shown in Fig. 3, when the apparatus launched from the top of the Watkin tower, 160 feet high, while swaying in a 40-mile wind similar to a bird in strong cross currents, retained its balance perfectly, reaching *terra firma*, though but a short distance away, on a perfectly level keel. A previous trial with the weight more forward from the center caused the apparatus to plunge headlong. Sufficient experience, however, with the full-sized models, has justified the construction of two new winged apparatus on new and more advanced lines, more in accordance with Nature's plans. The first is for individual or one-man flight, for use with a gasoline engine of 6 horse-power, the wings being deeply concave with semi-rigid anterior margins, and graduating posterior edges. One pair only will be employed, each 8 feet long by 6 feet wide, with a fan-shaped tail at the rear. It is estimated at 240 reciprocating strokes per minute the machine will be propelled in an ascensional and forward flight of at least 180 feet per minute, or 3 feet per second. The second apparatus, on the same lines, has eight wings measuring 18 feet from tip to tip, flapping alternately to conserve weight and driving power. It will be tested with a gasoline motor of 50 horse-power. A third machine, nearly completed, is now on the top of the Watkin tower (Fig. 3), Wembly Park, England, and is the favorite machine of the writer. It is 70 feet long, 10 feet wide at the center, and will be elevated by thirty ascensional screws 5 feet diameter, with a fine pitch. There are four propulsive screws seven feet each in diameter, capable of revolving at high speed, driven in opposite directions. The whole machine will be driven by a gasoline engine of 100 horse-power weighing 400 pounds.

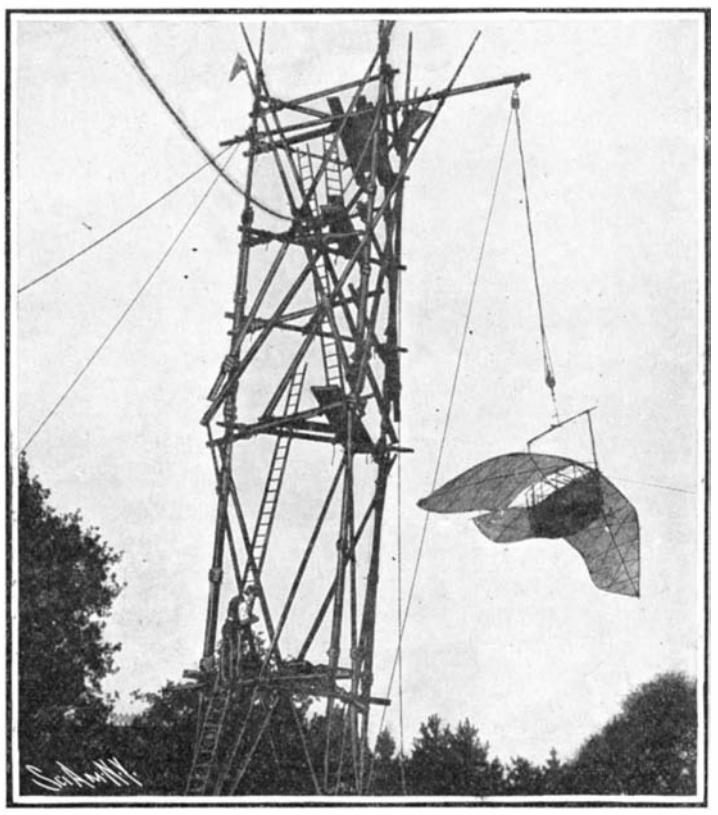


Fig. 2.—Attempts Were Made With and Against the Wind with the Apparatus Held Perfectly Horizontal.

Lippmann's Improved Method of Color Photography.

Prof. Lippmann has lately found a new method for obtaining photographs in natural colors by the use of a bichromated film, and obtains some very striking results.

In the author's well-known process, we can reproduce colors by using a transparent sensitive layer which is placed against a mercury bath during the exposure. After developing, the original colors of the object are seen by reflection. The nature of the sensitive layer is indifferent. We may use gelatino-bromide of silver, a layer of albumen, gelatine or cellulose bichromated, etc. To operate with cellulose, a solution of it is flowed upon glass. After drying it is bleached by washing in dilute hydrochloric acid and then treated with a 3 or 4 per cent bichromate solution. The dried layer is exposed in a frame adapted over a mercury bath until a trace of the image is observed in brown. It only remains to wash out the rest of the bichromate with water, when the colors appear at the same time. In this case the colors are seen only while the layer is wet. They disappear upon drying, but come back when the layer is again treated with water. This action seems to be due to the effect of light upon the hygroscopic properties of the film. The bichromated substance becomes less swelled by the water where the light has been strongest, that is, in the maxima of interference. Wetting makes the layer heterogeneous from a physical and an optical standpoint, and the effect is distributed in the mass according to a periodic law. M. Lippmann then sought to replace the water by a solid substance. Using an iodide of potassium solution, he finds that after drying the image is faintly visible. The unequal distribution is thus maintained, and we have the resulting interference effects. If now we treat the dry layer charged with iodide of potassium with a nitrate of silver solution (20 per cent) the colors become very brilliant and the effect is remarkable. No doubt the same unequal distribution is kept up with the iodide of silver which is formed in this case, but the film still remains transparent, and the iodide seems to be in the state of solution in the film. By observing the plates which are thus formed by transparence, the image appears in its complementary colors and the negatives which are thus obtained are striking. If in the future we are able to secure the same results with gelatino-bromide of silver, we could then make proofs in printing frame which would have the natural colors and obtain much better success than with bichromated films which are not very sensitive nor orthochromatic.

After the bursting of a flywheel in an American mill the superintendent designed and had constructed a large wooden flywheel 30 feet in diameter and 9 feet face. The rim is 12 inches thick, and is built up of forty-four courses of ash plank. The segments break joint, and are glued and bolted together. There are two hubs and two sets of arms, twelve in each set, and all of cast iron. The wheel weighs about 104,000 pounds, and was tested to a speed of 76 revolutions per minute, corresponding to a rim speed of 1.36 miles per minute.

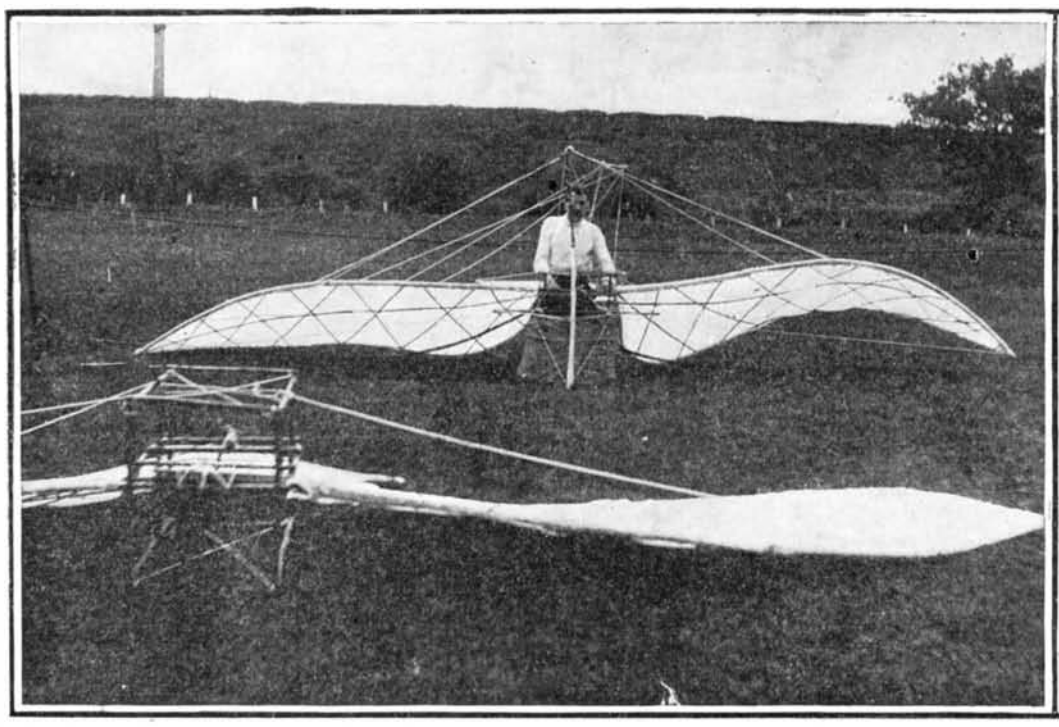


Fig. 1.—Two Pettigrew Wings.

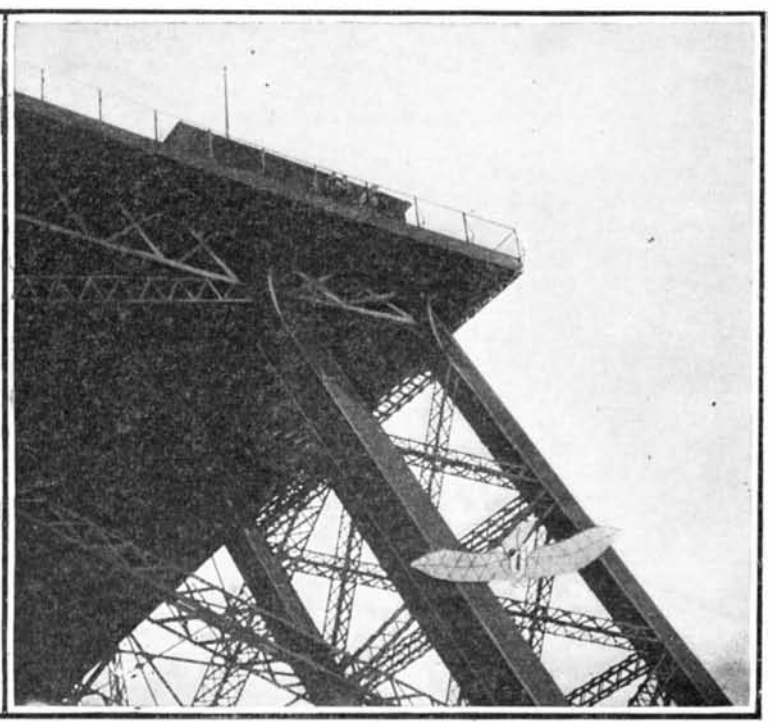


Fig. 3.—The 160-Foot Tower from Which the Apparatus Was Launched.

NATURAL AND ARTIFICIAL FLIGHT.

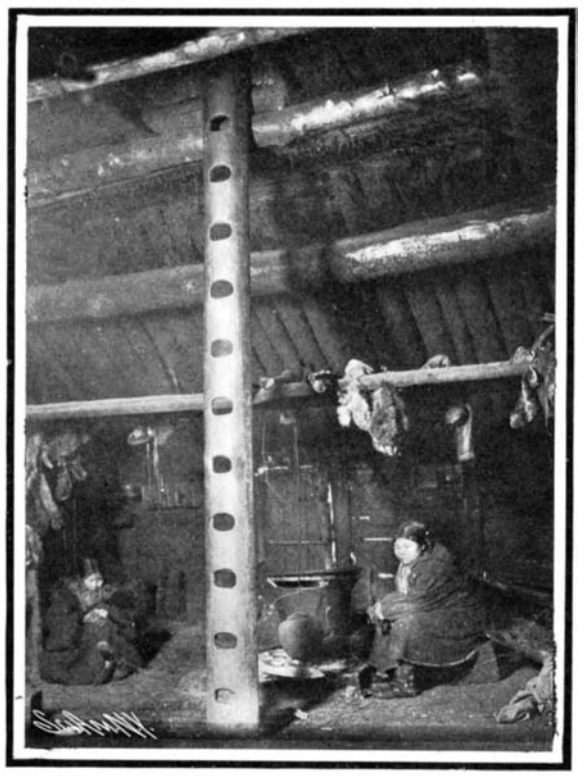
THE KORYAKS OF SIBERIA AND THEIR GREAT WHALE FESTIVAL.

BY WALTER L. BEASLEY.

The American Museum of Natural History, through the investigations of Mr. Waldemar Jochelson, the Russian scientist and traveler, who, for two years past, has carried on explorations at the head of the Jesup Siberian Expedition, will shortly announce some interesting and noteworthy results from these extensive and systematic surveys of the peoples of northeastern Asia. Mr. Jochelson has nearly completed his first memoir, and sails shortly for Europe, where he will continue preparing other volumes of the series. This explorer, together with his co-worker, Mr. Bogoras, brought back over ten thousand specimens, consisting of fur costumes, household utensils, and ceremonial objects, the largest number ever brought back from this region. The descriptive accounts of the whole expedition will portray the everyday life, religion, and customs of some of the most obscure and isolated dwellers on the earth to-day, adding a new and fascinating chapter to existing primitive life in Asia. The aim of the expedition was to settle the unsolved problem as to the early history of the native races of our continent and their relation to those of Asia. The final results of these investigations, though not entirely worked out at present, are enough to show conclusively that the isolated tribes of northeastern Siberia and those on the northwest coast of our own shores in remote times were one race, similar in type and possessing a common culture. Mr. Jochelson, in a recent interview, has favored the writer with some of the odd and characteristic modes of life and strange ceremonial customs of one of the native tribes visited by him, which will appear in his forthcoming volume.

Mr. Jochelson was the first white man to witness and gather a full interpretation of these mysterious rites and performances. Among the interesting races studied were the maritime Koryaks, living in scattered villages along the shores south of the Bering and Okhotsk seas, and also on the bays of Gishiga and Penshina. These resemble mostly in mythology and other ethnological points the Haida Tlinyit and Tsimshian of the northwest coast of America. They number about 10,000, and are separated into two divisions, the maritime and reindeer people. Both women and men wear boots and garments made of reindeer skin, which are obtained in exchange from inland deer breeders for oil, blubber, seal, and walrus thongs. The maritime Koryaks use dogs exclusively for traveling, which is done mostly in the winter months, when the whole country is covered with snow and ice.

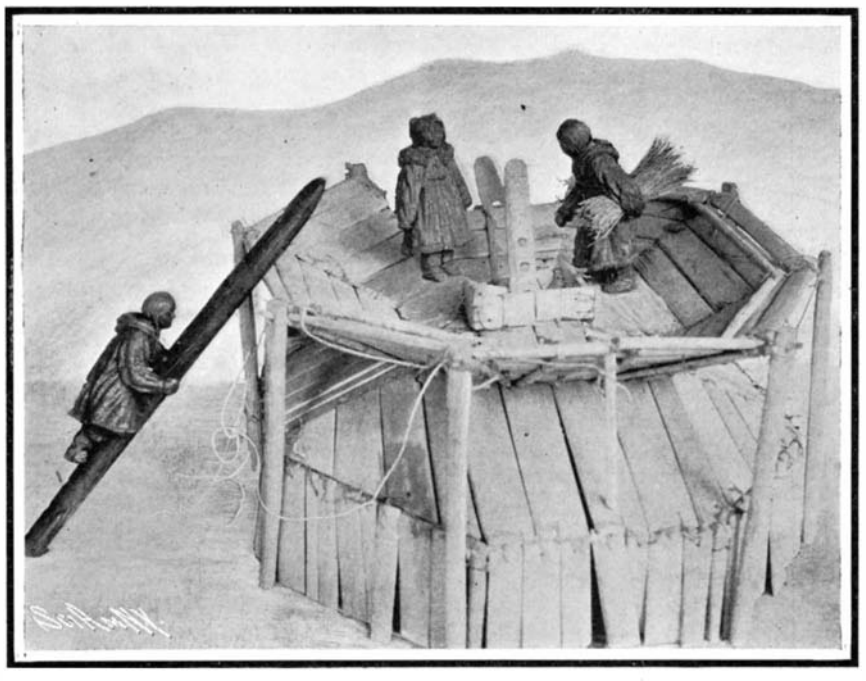
A striking and characteristic phase of Koryak life is their peculiar hour-glass-like houses. These are remarkable subterranean habitations, having a squalid atmosphere almost unbearable to the white traveler. From a distance one of the houses has the appearance of some huge inverted funnel arising out of a snowbank. The crater-like top, besides forming a roof, is used as a general storing place for food and all sorts of articles. It slopes downward to an aperture in the center, which serves as a smoke-hole, ventilator, and passageway below. A number of logs arranged in a circle support the framework of the roof, the lower end of which rests on a secondary pile of timbers, forming the slanting walls of the interior. For nearly nine months the whole house is banked and covered up almost to the protecting roof with tons of snow, chinked in with frozen earth and debris. This brings the inmates at all times about ten feet below the surface. Undoubtedly the most astonishing and spectacular feature of the Koryak house is the means of entrance. This is accomplished by scaling a narrow split log, extending down from the roof, having holes cut in it for the feet and hands. The interior is reached by descending another perpendicular hewn stairway covered with a slippery coating of grease and soot, which none but a native can successfully accomplish. The inclosure has a ground floor, and is barren of anything in the shape of furniture. Large copper vessels for cooking seal and blubber and a kettle used for melting snow are the chief household utensils. The diet is limited almost exclusively to fish, half-cooked seal and whale flesh, with Russian brick tea as an occasional luxury. Some thirty to forty of both sexes, usually relations, inhabit one dwelling. Small skin sleeping booths, some six feet high by five in width, heated by a lamp in the center, are arranged around the walls. These are assigned to married couples and the young girls, several of the latter occupying one booth. Invariably thick fumes of smoke and soot fill the room. Dogs play an important part in Koryak religion, which is full of Sham-



Interior of Koryak Underground House.

anism and magic. They are often offered as sacrifices and are thought to be one of the most potent agencies for keeping away evil spirits and maladies. For this reason the form of a dog is always hung from a roof top.

Mr. Jochelson was fortunately able to be present at one of the most curious and weird of all the Koryak



Koryak House in Northeastern Siberia, Showing Curious Ladder-Stairway to the Roof-Entrance.

ceremonials, namely, the whale festival, among the most important and spectacular events of the year. The main features are here related for the first time, and as a primitive ceremony full of magic and superstition, it is unquestionably unique, both in its conception and execution. The whale feast is held in the fall, after the animal has been caught. The essential part of the celebration is based upon the idea that the captured whale has come to visit the settlement, during which time he must be treated with great respect and hospitably entertained, for he is destined to return to the sea, where he will tell his companions of the good time which was given him, and induce his relatives to pay the Koryaks a visit, as he will probably do also. For, according to their mythology, all are one tribe of related individuals, and live in a settlement somewhere in the under-sea world. All the inhabitants of the village take part in the feast. The white whale is now very scarce in the bays of Okhotsk Sea. They are harpooned and caught in seal nets out on the ice floes in the open fissures, which they are compelled to frequent for breathing purposes. When the hunters are seen approaching with a sled, drawing the body of the animal, the women at once light a fire on the beach and don their dancing coats and boots and execute a sort of welcome dance, accompanied by singing the words: "Ala-la-la-ho! Ala-la-la-ho!" which means: "Ah! a dear guest has come." As soon as the sledge with the whale reaches the shore, the dancers return to their houses and remove their dancing costumes, and return with a large plaited grass mat to lay the body of the distinguished guest upon, and pails and utensils to gather the blood. The men carve up the whale; the meat, blubber, and skin are divided into parts and distributed to the hunters. The head, destined to play a prominent part in the celebration, is wrapped in a grass hood and put upon the roof of the storehouse. On the evening of the day the whale is captured, the first part of the celebration in honor of the mighty guest is given, in the house of the hunter who killed him. It was held in the largest of the underground houses of the settlement. The women and men from near and distant dwellings arrived at intervals, and ascended the steep log stairway to the roof, and descended again to the inside by a similar way. Many of the women were burdened with cooking vessels on the back and dangling offspring, yet they climbed the slippery and soot-covered logs with the greatest ease.

The interior of the subterranean edifice had a mysterious and gloomy appearance. Eight stone lamps, corresponding to the number of families participating in the festival, were burning around the room, and gave off a very unpleasant smell of seal oil. The walls, black with soot, completely absorbed the light of the lamps, and it was very difficult to discern the inmates, who were almost entirely shrouded in the vastness of the underground house. They seemed like apparitions moving to and fro. All spoke in whispers, for fear of awaking the guest before the right time. The women were busy cooking and mixing berries, edible grasses, and roots into puddings. The men were sitting silently in half-circles near the house-posts, while the youths and children were standing or sitting on the ground near the hearth. Near the left of the entrance was set up a sort of shrine or altar, on which were placed charms adorned with plaited grass. One of the most prominent of these charms was the sacred fire-board. This is one of the most essential and highly prized of the ceremonial objects of the Koryaks, and is employed in the first part of the whale festival. Besides acting as a fire-making apparatus, it is also considered a potent charm, and is supposed to take care of the welfare and to keep all evil spirits from the owner's household. The sacred fire-board is particularly the master of the underground house, and the helper in the hunt of sea mammals. It is usually a board of aspen wood crudely carved in the shape of a human figure, having eyes, nose, and mouth, with holes in it. In these a round wooden shaft is turned by means of a bow. The drill is held in position by a person pressing the chin or hand down on a bone socket arranged on the upper part of the drill, while the lower part is quickly revolved in the holes. Two or three are sometimes required to work this implement, though the aspen wood ignites readily. There is a rigid taboo against using the fire furnished by others or cooking on a strange hearth. The vessels of one family must not be brought into contact with the fire or hearth of another; if so, it would be a desecration to the family hearth, and is likely to prove infectious. When, owing to frequent use, the entire bed of the fireboard is filled with holes, a new one is made; the old one, however, is preserved as a cherished heirloom and kept in the place set aside for

Hauling the White Whale Ashore.

the sacred objects. Often fire-boards are found that have outlasted three or more generations.

After an interval all the families went out, and returned with bundles of fagots, and these were heaped up in a large fire on the hearth, which lighted up and made the interior less gloomy than before. Amid the silence that was still reigning the women placed kettles near the fire and melted in them the blubber of the white whale, and continued to whisper to one another. They finished the preparation of the puddings which the white whale was to take along on its journey to his former home. When they were ready, the women representing the different families passed from one corner to the other, and tendered presents in the shape of small pieces of the puddings. After this two men ascended the roof and brought down the head of the white whale, and suspended it on a cross-beam at one side of the house. The appearance of the honored head of the chief guest, symbolizing his entrance and presence among them, now broke the long silence which had reigned before. Instantly from all sides of the house were heard joyful exclamations of the women, saying: "Ah! here the dear guest has come! Visit us often! When you go back to sea, tell your friends to call on us also. We will prepare just as nice food for them as for you. We have plenty of berries," etc.—and they pointed with their fingers at the puddings that were placed on boards. Everybody in the house was now carried away with excitement. The men and children conversed loudly and crowded around the hearth; then the host, with a grass collar around his neck, took a piece of the fat of the white whale and threw it in the flame, saying, "We are burning it in the fire for thee!" After this he went to the shrine, and placed pieces of fat before the guardian fire-board and smeared its mouth with fat. This was a signal for general feasting to begin, and all those persons in the house began to partake of food. Here is the menu of the banqueters at this queer celebration of the Arctic world. They ate dried fish dipped in whale oil, boiled whale meat, broiled skin of the whale, and pudding. The ceremony had now reached its height. The heat had increased so that the men were compelled to take off their fur coats, while their bronzed forms, the excited countenances of the women, children's faces smeared with oil, ghost-like atmosphere from the smoke and soot from the lamps, produced a strange and unforgettable sight, bordering more upon the unnatural than the real.

On the following morning the company assembled to bid adieu to the honored hero of the deep. The hearth was converted into something like an altar; on it were placed the traveling bags filled with puddings that had been frozen outside, also the head of the whale, which was wound around with sacrificial grass. Two sisters of the owner of the house put on long grass masks and officiated as priestesses. They knelt before the hearth, bent their heads over the altar so that their masks covered the bags, and pronounced an incantation. The women, not supposed to have a strong heart, were afraid to meet with face uncovered the spirit of the white whale, which is believed to be present at the ceremony of the equipment for the home journey. After a divination performance, the people proceeded with the finale of the festival, the sending of the animal's head to its former habitat. Two men ascended the roof and let down into the house long thongs, to which the traveling bags and the head were tied. Puddings were also placed in these, and berries and sacrificial grass into the mouth for food. Thus festooned and provisioned, and having been furnished with five days' entertainment and feasting, the head was carried to the beach by the assemblage and launched into the sea. At the same time the following farewell incantation was pronounced: "Goodbye, dear friend! When the next high tide comes in, induce all your relatives to come with you!" It is thought that this incantation has the effect of bringing sea animals in with the following tide.

Covering Up the Whale-Guest on the Beach.

Plaiting the Grass Mat, Which is to be the Whale's Bed.

Grass-Masked Women, Pronouncing Incantation Over the Whale Head.

Koryak Woman and Child, Ready for the Festival.

Koryak Fire-Making Apparatus.

Ceremonial Grass Mask Worn During the Festival.

THE KORYAKS OF SIBERIA AND THEIR GREAT WHALE FESTIVAL.

The accompanying illustrations are reproduced by the courtesy of the American Museum of Natural History.

A New Use for Glass.

L'Illustration (Paris) publishes the following: Like reinforced concrete, reinforced glass is now more and more employed in buildings. Reinforced glass, the principle of which has been patented by an American, is made by rolling two sheets of glass between which is placed a metallic grating. The product shows remarkable cohesion and tenacity; and, in case of breaking, the pieces of glass, instead of separating, remain adherent, held by the metallic grating. That is the principal advantage of reinforced glass. By interesting experiments, recently made, MM. Schlernitzauer and Crocket have proved that a plate of reinforced glass, slightly less than a quarter of an inch thick, and a trifle over four feet long by about a foot and a half wide, could support a weight of about 1,047 pounds. Under 1,322 pounds it did not break, but was only bent and cracked. Reinforced glass has another important property: a small building, the walls of which are made of reinforced glass, resists a very lively fire lit on the inside; whereas an ordinary window breaks at the first touches of the flame.

Such properties clearly fit reinforced glass for roofing, shop-windows, and glass partitions; but its application to the construction of staircases is particularly successful, for glass staircases allow the easy lighting of the descents into basements. Their steps are not slippery, and, in case of fire, their superiority over wooden staircases is incontestable.

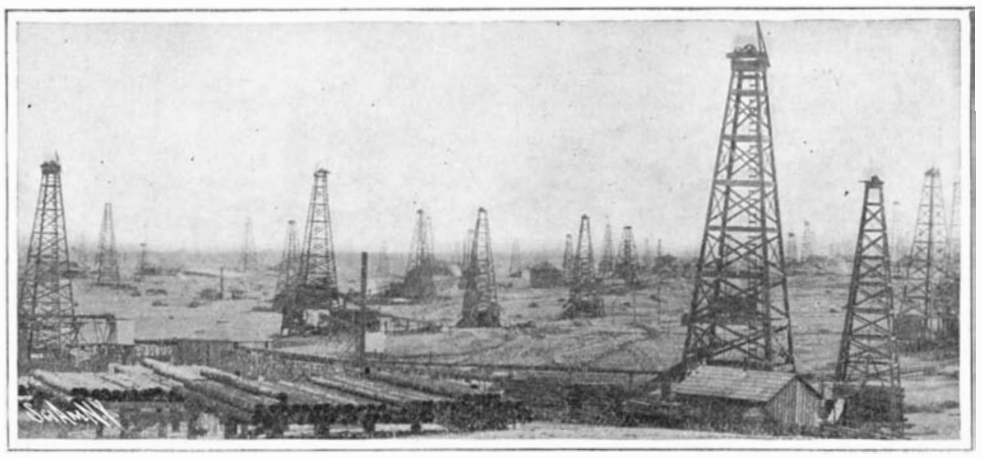
The Academy of Sciences of Vienna lately awarded the following prizes for scientific work in various fields. M. Oscar von Wünscheim received a prize of 1,000 crowns for his researches upon the questions relating to the theory of immunity of animals, vaccination, etc. M. Jellinsch, of Vienna, was awarded a prize of 500 crowns for his work in the field of electro-pathology. M. E. Finger, of the same city, received a prize of 2,000 crowns which will enable him to continue his important researches in the question of contagion of syphilis in the case of monkeys. A prize of 2,000 crowns was adjudged to E. Emisch, of Prague, for his researches upon the density of gases.

THE OIL FIELDS OF THE WEST.

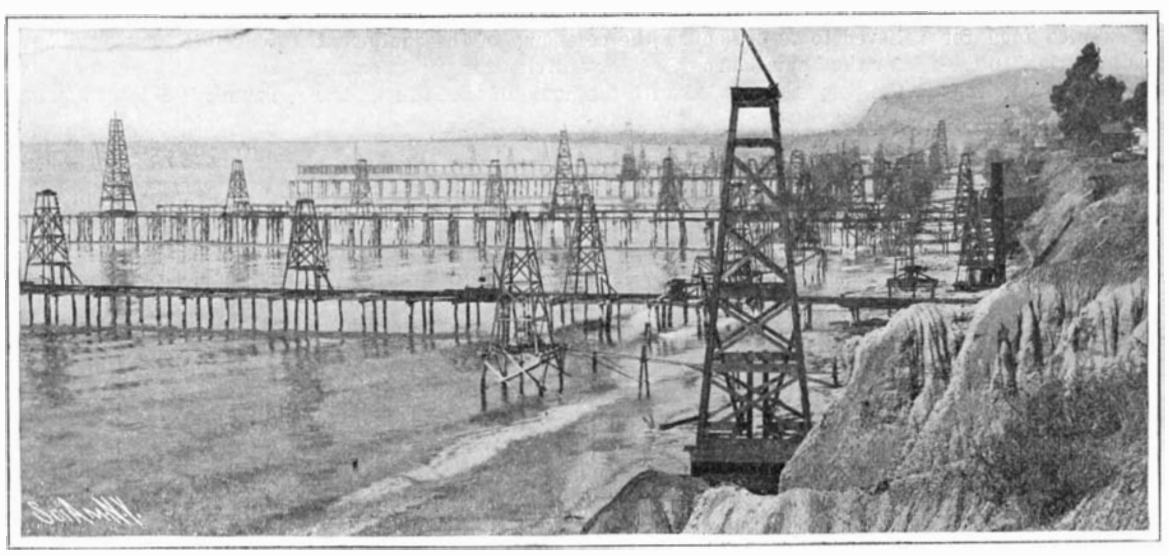
BY DAY ALLEN WILLEY.

For the first time in the history of the American petroleum industry, the center of production of this staple has gone beyond the Mississippi River, wells of the West and Southwest during 1904 yielding more oil than the older fields comprised in Pennsylvania, Ohio, Indiana, and West Virginia. Reports compiled by the United States Geological Survey show that during the year 1904, out of a total production of 119,000,000 barrels, over one-half was represented by the States of California, Texas, Louisiana, Kansas, Colorado, Wyoming, and Indian and Oklahoma Territories. A conservative estimate places the total quantity from the fields of the West and Southwest at 63,000,000 barrels.

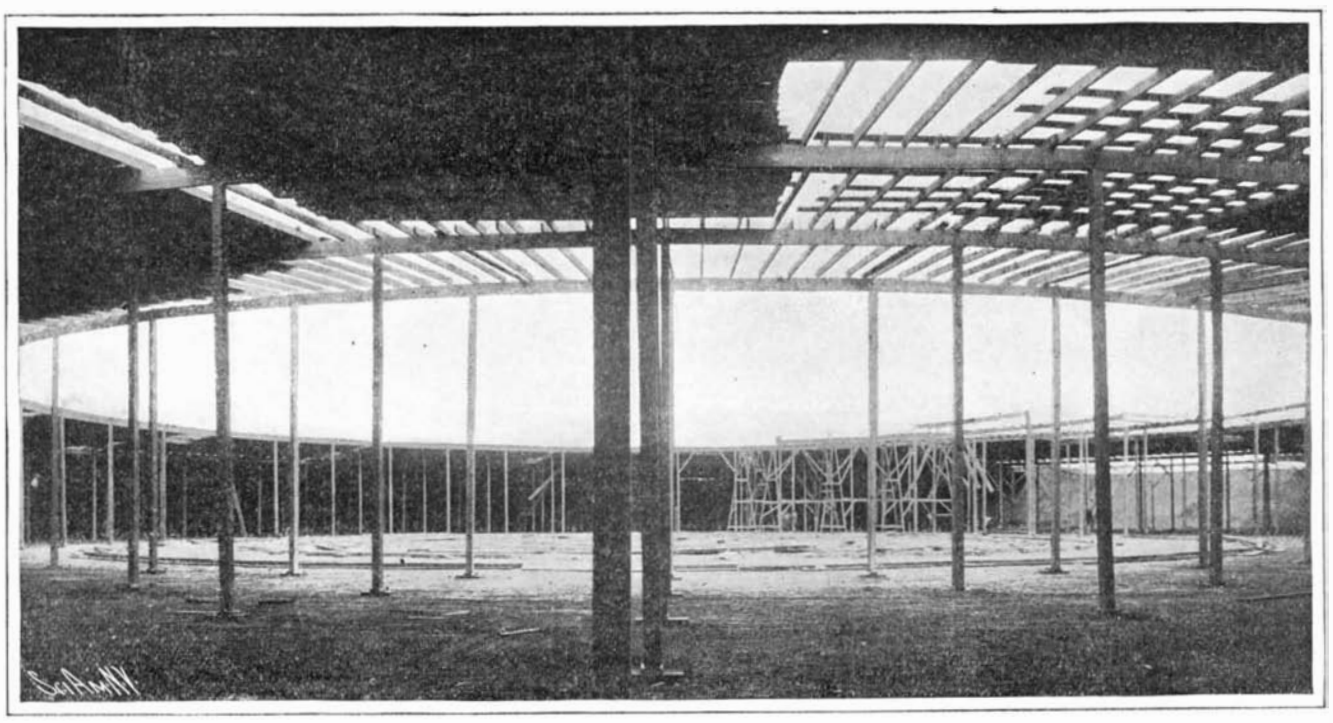
The development of the oil-bearing sands in the West within the last few years has been truly phenomenal, when the records of past years are considered. Until recently the Appalachian and Lima-Indiana deposits have produced such a large percentage of petroleum that the quantity secured outside of this area has been so small as to be insignificant. For example, in 1898 the eastern fields yielded no less than 93.99 per cent of the total, according to the government statistics. The deposits in California in 1897 were comparatively small, for the total quantity represented by this State for that year amounted to less than 1,500,000 barrels. Prior to the "coming in" of the Spindle Top district in Texas, but 4,000 barrels of oil were being secured daily from the 600 wells at that time in operation in this State. In 1903, however, the industry in the West and Southwest had so expanded that it represented nearly 45 per cent of the total yield, a decrease being noted in Pennsylvania amounting to 708,724 barrels. In all, the Appalachian and Lima-Indiana regions decreased during the same year about 4 per cent compared with 1902, so that the total increase for the country came from the newer districts, although it represented nearly 12,000,000 barrels of the total of 100,461,337 barrels. Remarkable as are these figures, the development since then has been far more rapid, as is shown by comparing 1904 with the preceding year. California alone furnished fully one-fourth of all the petroleum during 1904, maintaining its position as the greatest oil-producing State, although in 1903 its record was about 25,000,000 barrels. From the wells of Kansas in 1903 came but 600,000 barrels, although this quantity was 181 per cent more than in 1902. In 1904, however, Kansas and the two Territories adjacent to it furnished no less than 6,000,000 barrels—a greater percentage of increase than any other section of the country, more than quadrupling their output for the previous year. Contrasting these figures with the yield from the principal foreign fields, it may be said that the United States is now supplying 60 per cent of the world's petroleum—fully 34,000,000 barrels more than Russia, estimating the quantity secured from the Baku and other districts of the empire at 85,000,000 barrels annually—the latest calculation. The West and Southwest alone contributed last year a quantity equal to 74 per cent of the total Russian yield, but these statistics do not include many wells which have been brought in during the last four months, and in the estimate one of the most important of the newer fields is entirely omitted, since it has only begun producing in quantities within the last two months. The States and Territories cited form only a portion of the oil-bearing area of the West and Southwest, which indicates its extent. As a matter of fact, however, paying wells have been bored in other sections, and today the traveler may see derricks erected all the way from the Mississippi River to the Pacific coast, while the width of the possible fields from north to south can only be imagined as yet. Predictions have been made, that the present year will have a showing of 150,000,000 barrels for the United States. When the production of the newer fields is analyzed, and consideration given the activity in boring wells and exploiting additional territory, these figures do not appear to be exaggerated. It can be said without contradiction that the industry in California and Texas has never covered a wider area, nor has it been more active. Despite the fact that the quantity from the older fields in Texas has considerably diminished, each is still yielding sufficient oil to maintain the industry on an important scale. True, nearly all the producing wells in the Spindle Top field are



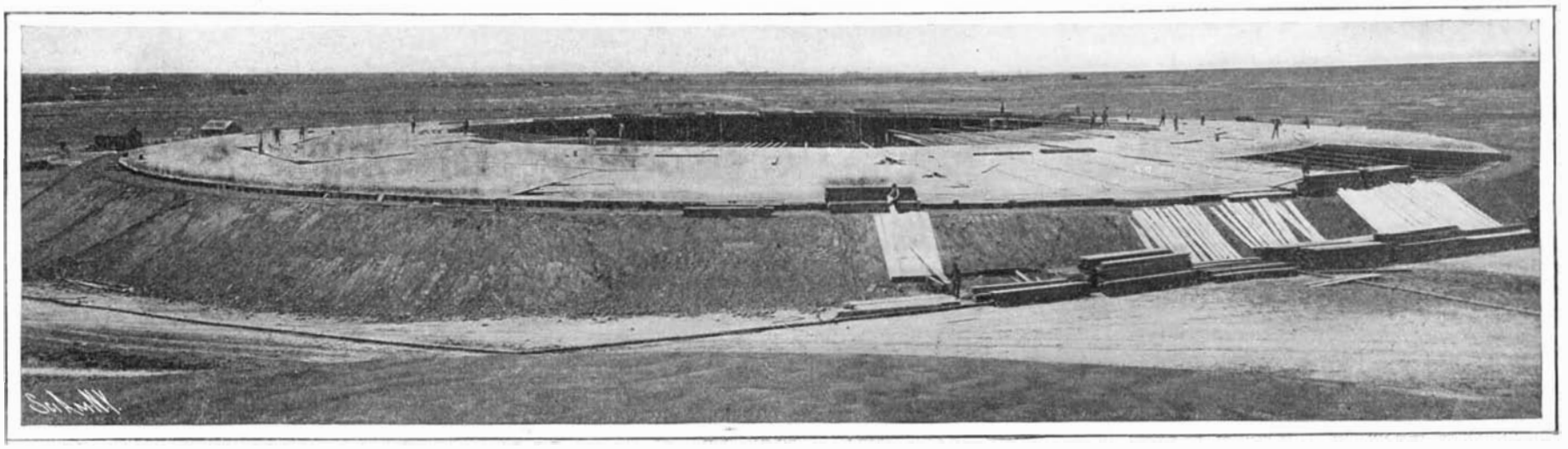
A Few of the Many Oil Derricks in the Field.



A General View of the Oil Field.



Reservoir Partly Covered.



Covering a 500,000-Barrel Oil Reservoir.

THE OIL FIELDS OF THE WEST.

being pumped, but there is no question that a very large deposit still underlies this portion of the State. Where in 1901 Spindle Top was its only field of any consequence, to-day Texas contains no less than five districts, the others being Sour Lake, Saratoga, Batson, and Humble, named in the order of their development. The Humble field was unknown at the beginning of the year, but the latest estimate puts its daily yield at between 80,000 and 85,000 barrels, although at the time of writing less than seventy-five flowing wells have "come in." Should these figures be maintained, the Humble will furnish more petroleum than all the others in the State. In Kansas and the Territories rigs have been erected in so many portions that it may be said that the industry is general in this part of the country, and it would not be surprising if even the present remarkable figures were greatly exceeded. In the State alone but 735 wells were producing oil in June, 1903. In six months the number had doubled, and at present it is estimated that fully 2,500 are flowing sufficiently to pay for their operation. The Chanute, the most important field, contains nearly one-half of this number, yet is still being exploited on an extensive scale.

Apparently California promises to remain at the head of oil-producing States, despite the wide range of territory which has already been covered. The beginning of the industry was in the suburbs of the city of Los Angeles, when in 1892 the first paying well was sunk. A year later the Newhall district, as it is called, supplied about 100,000 barrels. Since that time important deposits have been found not only in Los Angeles County, but in Ventura, Santa Barbara, Kern, King, and Fresno. The activity in Kern has assumed very large proportions. During 1904 it contributed fully 20,000,000 barrels of the California output, but the supply which exists in the original field is such that over 1,000 wells have already been bored in Los Angeles County, and this number will be considerably increased during the present year. Another important territory which added to the western and southwestern contribution during 1904 is the Jennings field in southern Louisiana. This is undoubtedly a portion of the oil-bearing sands which have been reached in Texas, and as it is located no less than 200 miles east from Humble, there is reason to believe that more or less petroleum exists all the way between these points. At present the output in the vicinity of Jennings averages 1,000,000 barrels monthly alone.

In considering the supply of petroleum from the West and Southwest as compared with the East, an important factor to be remembered is the wide diversity in the quality of the product. Thus far none has been found in California or Texas which is of as high grade as that secured from the Appalachian or the Lima-Indiana region. As is well known, the Pennsylvania oil yields the most value. One hundred gallons of the crude represents about 76 gallons of fair grade illuminating oil, 3 gallons of lubricant, and 11 of the naphtha grades. The quantity of waste seldom exceeds 5 per cent. As yet practically all of the petroleum having a paraffine base comes from the eastern district, while the asphalt represents a large proportion of the western product. To a certain extent sulphur is also found, especially in the Texas oils, which further reduces its value for commercial purposes. As refining in the West and Southwest is principally by means of intermittent distillation, the cost of purifying the crude oil is considerably greater than in the older fields. By the present methods about 20 per cent of the California and Texas oils can be obtained for illumination—nearly 50 per cent less than the paraffine grades of the East. To extract the sulphur it is usually necessary to redistill the liquid, treating it with copper oxide—an expensive process. For these reasons the great bulk of the Western oils are marketed in their crude state, being used chiefly for fuel, although kerosene and naphtha for local consumption are obtained both on the Pacific coast and in Texas, while the manufacture of lubricating oil is rapidly increasing. Since the construction of pipe lines from the principal fields, and the erection of tanks and other reservoirs at convenient points, the economy of this liquid fuel has been so appreciated that the majority of the railroad companies, especially in the Southwest, have substituted it for coal. It is also being supplied to sugar refineries and other industries for use in connection with stationary engines, and a large fleet of steamers plying from Pacific coast ports are burning it exclusively. Apparently the quality of the Western and Southwestern oil is not deteriorating, and as more and more sources of consumption are being found for it, the demand is rapidly increasing, although not in the same proportion to the supply.

The following table, showing the carbon and hydrogen in oils from the American districts, will assist in giving an idea of the quality of the several products:

	Carbon.	Hydrogen.
West Virginia heavy oil	83.5	13.3
West Virginia light oil	84.3	14.1
Pennsylvania heavy oil	84.9	13.7
Pennsylvania light oil	82.0	14.8
Texas oil	86.8	13.2

THE JAPANESE NAVY AFTER THE WAR.

The task that confronted the little Japanese navy at the outbreak of the recent war was simply stupendous. By the book, and on paper, it was simply impossible of accomplishment. Theoretically, by all the laws of naval strategy, that navy should have been at least three times as large as it was to accomplish with certainty the work that confronted it. At the outbreak of the war the naval forces of Japan and Russia in eastern waters were approximately equal; but for Japan successfully to accomplish what she set out to do, what it was absolutely necessary she should do if she were to win on sea and land, required a navy, and this without any reference to the fleet in reserve in the Baltic, practically double the size which she had at command. To blockade a superior fleet of battleships in Port Arthur and a squadron of armored cruisers at Vladivostock; to provide transport for nearly three-quarters of a million of men from Japan to Manchuria, convoy that transport, and maintain its lines of communication so secure that the fresh reserves, the wounded, the hundreds of thousands of tons of provisions, ammunition, guns, and general army supplies, might pass to and fro without fear of interruption—all this was a task for which a navy double the size of that of Japan would have been considered by the naval strategist none too strong. Furthermore, the seemingly insuperable task (we are now weighing the question as it was weighed before the events of the war had opened our eyes) confronting the Japanese navy was rendered doubly discouraging by the fact that the waste of war in ships and general war material would be, for the Japanese, irreparable, whereas the enemy possessed in the Baltic reserves a fleet that was approximately equal in power, and in its principal units more modern in type, than the one with which Japan had immediately to deal in eastern waters. So that it was necessary, not merely to defeat and destroy an enemy who by virtue of his strategical position was stronger than themselves, but the victory must be accomplished with the minimum of loss of ships—that is, if the Japanese remnant was not to be overwhelmed when the Baltic fleet reached the scene of conflict.

It is easy to be wise after the event; but at the opening of the war of 1904, the naval strategists would have told us that if Japan won out "by the skin of her teeth," and with but a pitiful remnant left of her own navy, it would be a most brilliant feat of arms. We doubt if even among the Japanese themselves, well informed as they were as to the actual efficiency of the enemy, it was expected that the successful termination of the war would leave their navy anything but sadly wrecked.

All the more splendid, then, are the results as they are recorded in the tabular statement which is herewith presented to the readers of the SCIENTIFIC AMERICAN; for not only did the Japanese navy cheerfully accept and patiently bear the double burden imposed upon it, but it has emerged from the struggle actually 50 per cent stronger than it was at the outset.

Of late, this Oriental race has shown to the western world some new and better ways of doing certain things in which the western world supposed itself to be pre-eminent. Japan has proved that it is possible for the personnel of a navy to be so perfect in skill, discipline, and dauntless courage, that it can not only win out decisively against an enemy numerically superior, but that it may emerge from the conflict more powerful in ships and material than it was when the opening gun was fired. The Japanese navy performed many brilliant feats during the progress of the war; but not one of them was, in its way, more remarkable than the skill with which they recovered a whole fleet of Russian warships from the mud at Port Arthur and Chemulpo, took it over sea to Japan, and pushed forward the repairs so successfully as to make it possible for every battleship and cruiser before many months to go into commission under the flag of the Rising Sun.

Interest in the conflict, at least in the United States, died out so quickly and absolutely with the signing of the Treaty of Portsmouth, that the American people have failed to realize the profound significance of those occasional telegrams from Tokio which have appeared during the past few months, stating that this battleship or that cruiser had been refloated and taken to Japan. As a matter of fact, every such announcement meant that the Japanese navy was receiving an addition of strength and taking a higher stand among the navies of the world which, under ordinary circumstances, would have required four or five years for its accomplishment. We are informed by Japanese naval officials that the damage done to the sunken fleet by Japanese mortar fire, and by explosives applied by the Russians themselves, is surprisingly small in comparison with what would naturally have been expected. Every one of the eleven battleships and cruisers that has been captured or refloated is capable of thorough repair. Although many of them are badly knocked about between wind and water, the amount of damage below the waterline is unexpectedly small, and not one of the heavy blows struck by the mine or the torpedo, or the large high-explosive shell, has impaired the integrity of the structure of the ship as a whole. Protective decks and waterline belts have done their work most effectually. Instances of penetration of the vitals of the ship are few; and the shells that did enter have wrought no damage that cannot readily be made good.

Without disparaging the skillful work done by the Japanese wrecking crews, it may be said that the salvage of the Port Arthur fleet is a splendid tribute to the genius of the naval architect. It is a complete verification of those theories of watertight subdivision and the combination of belt and deck armor, which have produced the many-compartmented modern warship. To be convinced of this, recall for a moment the prodigiously rough treatment to which this Port Arthur fleet has been exposed in the last two years. Torpedoed in the first night attack; pierced at the waterline in the offshore engagement next day; patched up temporarily by the use of wooden cofferdams; struck repeatedly by mines (in the case of one ship twice in the same spot); again repaired under emergency conditions; taken to sea and put through a fleet engagement of seven hours' duration; brought back to Port Arthur, to be finally sunk under a four days' bombardment by 11-inch shells; wrecked by heavy charges of gun-cotton applied within and without by the Russian officers themselves—these ships, after spending six to eight months at the bottom of Port Arthur harbor, are floated, and some of them taken under their own steam across the stormy Sea of Japan to be repaired and put in first-class shape at Japanese dockyards.

That the ships were raised at all was due largely to the elaborate system of watertight compartments. To illustrate how complete this is, we show several views of that portion of the French battleship "Charles Martel" which lies below the protective deck. This vessel is selected because the later Russian ships are either of French construction or follow French designs. We do not know the total number of compartments in such a ship as the "Pobieda," but how complete is the modern system of subdivision may be judged from our own battleship "Connecticut," now building at the Brooklyn navy yard, which has 71 separate watertight compartments in the double bottom, 155 between the double

Japanese Navy After the War.

Battleships.

Name.	Date.	Displacement.	Original Trial Speed.	Remarks.
Kasuga	1906	16,400	18.5	Nearly completed.
Katori	1906	15,9 0	18 5	Nearly completed.
Mikasa	19.0	15,200	18.6	
Asahi	1899	15,200	18.3	
Shikishima	1898	14,850	18.8	
Iwami	1904	13,566	18.0	Ex Russian Orel.
Hizen	1900	12,700	18.8	" Retvizan
Fugi	1906	12,500	18.5	
Suwo	1900	12,670	18.5	" Pobieda
Sagami	1898	12.670	19.1	" Peresvıet
Tango	1895	11,000	16.5	" Poltava

11 Ships of 152,706 tons.

Coast Defense Ships.

Iki	1892	9,700	14.8	Ex Russian Nikolai
Okinoshima	1898	4,126	15.0	" Apraksin
Mishima	1895	4,648	16.0	" Seniavin
Chin Yen	1882	7,350	14.5	

4 Ships of 25,974 tons.

Armored Cruisers.

Kasuga	1904	7,700	20	
Nisshin	1904	7,700	20	
Aso	1902	7,800	21	Ex Russian Bayan
Asama	1898	9 750	22	
Tokiwa	1898	9,750	22.7	
Izumo	1899	9,800	22.0	
Iwate	1900	9,800	21.8	
Adzuma	1900	9,436	21 0	
Yakumo	1899	9,850	20.7	

9 Ships of 81,686 tons.

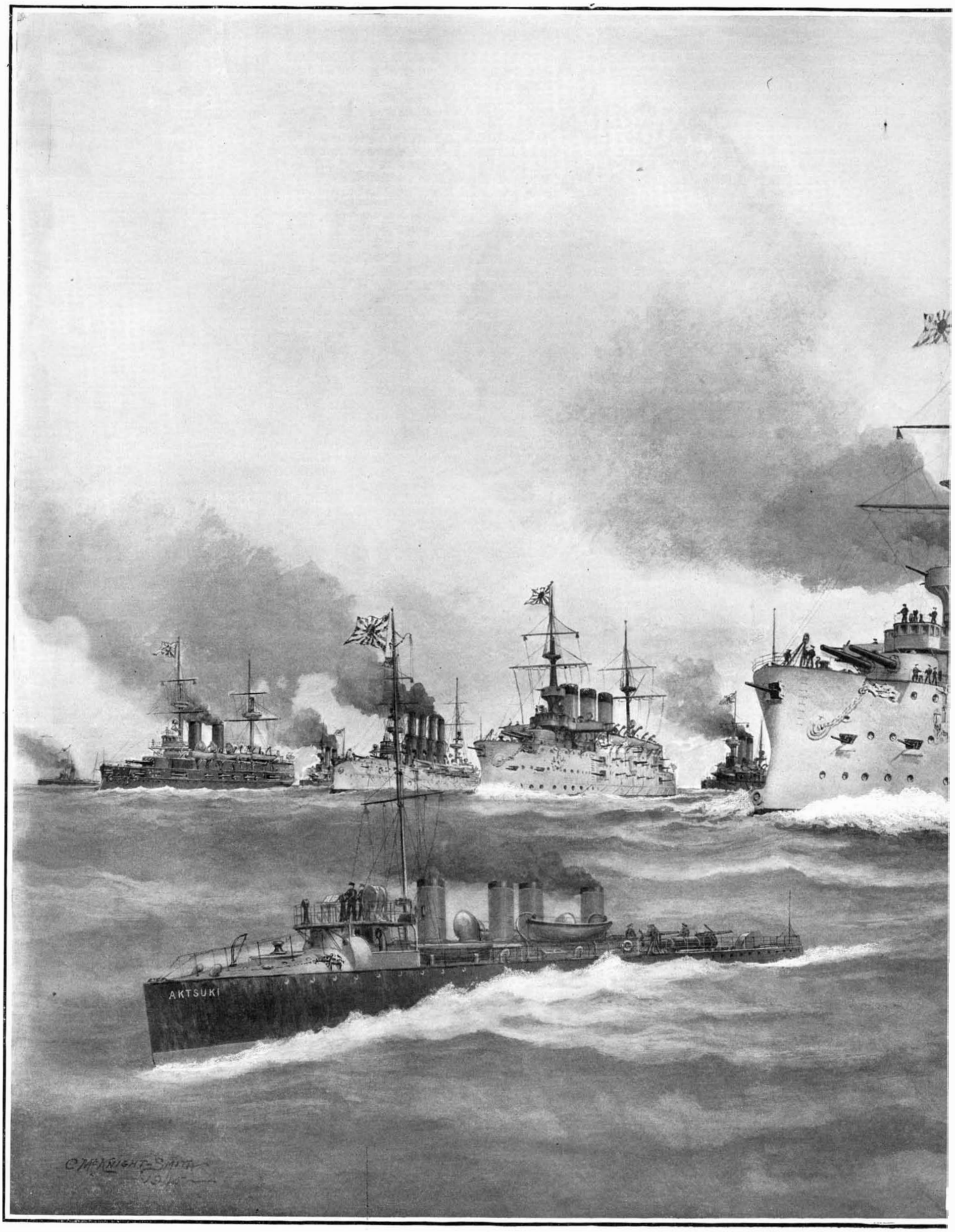
Protected Cruisers.

Soya	1899	6,500	24.6	Ex Russian Varing.
Tsugaru	1900	6 630	20.0	" Pal'ada.
Chitose	1898	4,760	23.8	
Kasaji	1897	5,416	22.8	
Akasi	1897	2,657	20.0	
Suma	1895	2,657	20.0	
Akitsushima	1892	3,150	19.0	
Idzumi	1884	2,800	18.0	
Chiyoda	1889	2,450	19 0	
Hashidate	1891	4,277	16.7	
Itsukushima	1889	4,277	16.7	
Matsushima	1890	4,277	16.7	
Naniwa	1885	3,700	18.7	
Takachiho	1885	3,700	18.7	
Niitaka	1904	3,4.0	20.0	Completed during war
Tsushima	1904	3,420	20.0	" "
Otawa	1904	3,000	20 0	" "
Miyako	1901	1,800	20.0	Sunk and re-floated
Yayeyama	1891	1,600	20.0	
Chihaya	1901	1,250	21.0	

20 Ships of 71,741 tons.

Japanese Navy Before and After the War.

	1904	1906	Increase.
Battleships	85,250 tons	152,706 tons.	67,456 tons (80%)
Coast defense	9,350 "	25,974 "	16,624 " (178%)
Armored cruisers	73,886 "	81,6 6 "	7,800 " (10%)
Protected cruisers	55,301 "	71,741 "	16,440 " (30%)
Totals	223,787 tons	332,107 tons.	108,320 tons (48%)



Gunboat "**Gaidamak.**"
400 tons, 22 knots.

Coast defense "**Mishima**" (*ex* "*Seniavin*")
4,648 tons, 16 knots.

Battleship "**Suwo**" (*ex* "*Pobieda*")
12,670 tons, 18.5 knots.

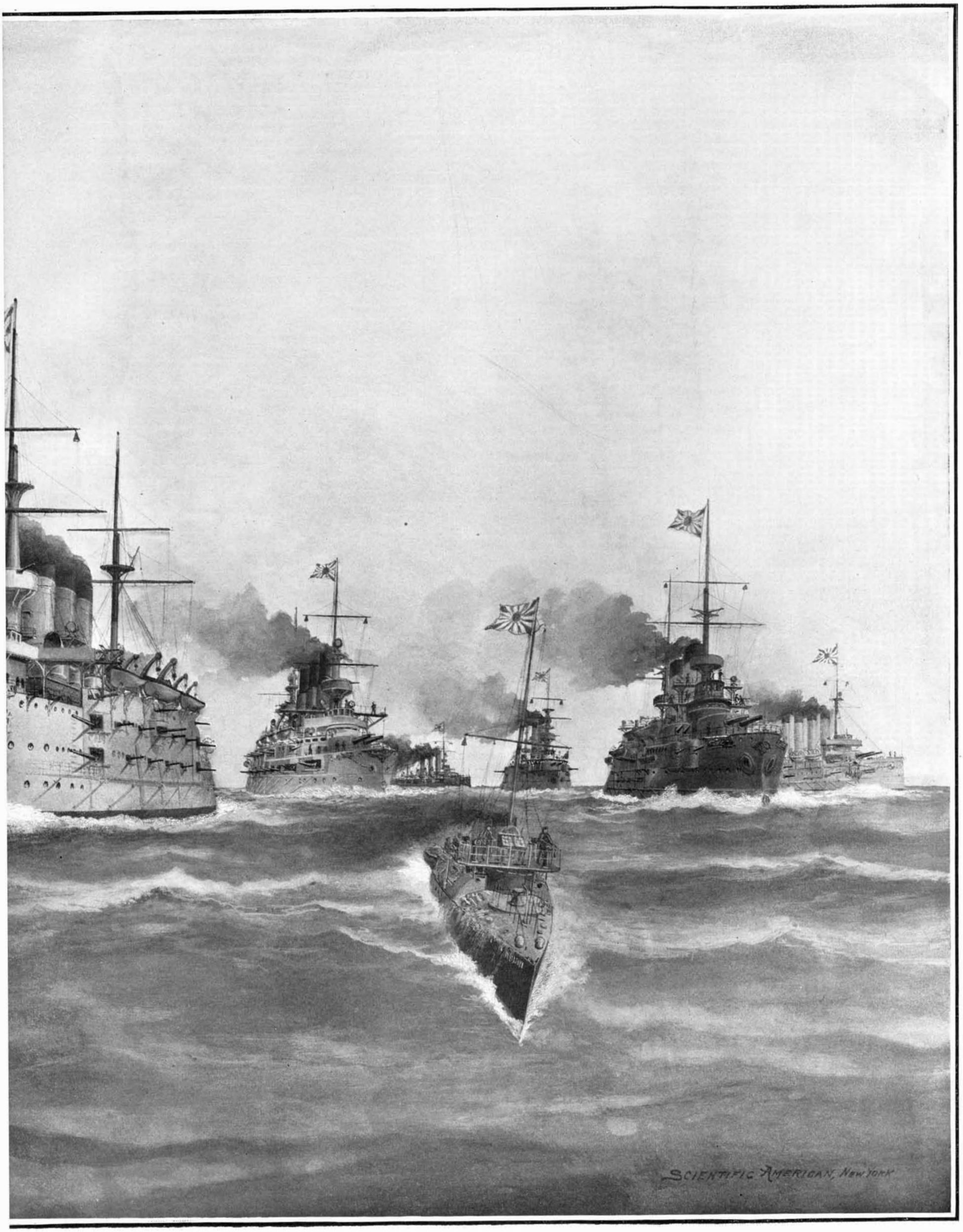
Battleship "**Sagan**
12,670 t

Second-class battleship "**Iki**" (*ex* "*Nikolai*")
9,700 tons, 14.8 knots.

Protected cruiser "**Soya**" (*ex* "*Variag*")
6,500 tons, 24.6 knots.

Coast defense "**Okinoshima**" (*ex* "*Apraksin*")
4,126 tons, 15 knots.

RUSSIAN WARSHIPS RE-FLOATED AT PORT ARTHUR AND CHEMULPO AN



…ai" (*ex "Peresviet"*)
…ons, 19.1 knots.

Protected cruiser "**Tsugaru**" (*ex "Pallada"*),
6,630 tons, 20 knots.

Battleship "**Iwami**" (*ex "Orel"*)
13,566 tons, 18 knots.

Battleship "**Hizen**" (*ex "Retvizan"*)
12,700 tons, 18.8 knots.

Battleship "**Tango**" (*ex "Poltava"*)
11,000 tons, 16.5 knots.

Armored cruiser "**Aso**" (*ex "Bayan"*)
7,800 tons, 21 knots.

D CAPTURED IN THE SEA OF JAPAN THAT NOW FLY THE JAPANESE FLAG.

bottom and the protective deck, and 101 above the protective deck, making a total of 327 in the whole ship.

In salving these vessels, the Japanese divers first went down and closed all holes in the shell of the ship with timber, canvas, and cement, or other material; shut all the watertight doors that were accessible; and then put powerful pumps at work to empty the water from the hull. In the case, for instance, of the battleship "Peresviet," two salvage steamers were placed one on each side, and their powerful pumps were assisted by a centrifugal pump and three pulsometers which were on board the ship itself. When all these pumps were working together, the enormous amount of 13,000 tons of water per hour was pumped out of the ship. This is more than the total displacement of the ship at her normal draft. The "Peresviet" was immersed 7 feet in the mud, and, as she lifted, the divers, of whom there were twelve squads, went carefully around the ship, closing all openings into the hull. From June 30 to July 2 the ship lifted 3½ feet; on July 3 she lifted 3 feet more, at which time she was immersed only about 3 feet below her normal draft. In spite of the fact that twelve holes made by 11-inch mortar shells were visible in the upper deck, of which four pierced the protective deck, and although four large holes were reported by divers as existing below the armor deck, one of which was 18 inches deep by 7 feet long, it is evident that no vital injury was done to the ship; for after being raised she was taken to Sasebo, Japan, under her own steam.

The same feat was performed with the armored cruiser "Bayan," and the battleship "Poltava" was also found to be navigable under her own engines.

As a matter of fact, the condition of these ships, as revealed by the Japanese, confirms the statement made to the Editor of this paper by several Russian officers, that the effect upon a warship of high explosives, whether exerted by the shell, the torpedo, or the submarine mine, is strictly local. The plating, framing, or what-not, that comes within the immediate radius of the explosive gases, is blown in or torn asunder by the energy of the gases or the flying fragments; but the structure of the ship as a whole is not affected. Neither the vessel itself, nor its engines, are thrown out of line, or wrenched, or twisted; and hence, the best answer to make to the increasing range of gun and torpedo, and to the hidden menace of the submarine and the mine, is to multiply the subdivision and still further localize the effect of the blow.

In conclusion, we draw attention to the enormous gain in strength of the Japanese navy, due to the inclusion of these captured and refloated Russian ships. The work of new construction was carried on during the war to an extent that more than offsets the Japanese losses. The battleships "Kasuga" and "Katori," the most powerful afloat, each carrying four 12's and four 10's, and twelve 6's, will be completed early in 1906, or say two years from the beginning of the Russian war; and the Japanese themselves completed three 20-knot cruisers of about 3,000 tons displacement. Five battleships, three coast-defense ships, one armored cruiser and two large protected cruisers of the late Russian fleet have been added to the navy; and it is probable that, in the case of the battleships, the Russian armament will be replaced by much more powerful guns of the wire-wound type of Japanese manufacture. The speed of these ships is high, and they may be considered, when re-armed, as being well up to date. The increase of the Japanese navy by accretions, during and after the war, is as follows: In battleships there is an increase of 67,456 tons, or 80 per cent; in coast-defense vessels an increase of 16,624 tons, or 178 per cent; in armored cruisers there is an increase of 7,800 tons, equal to 10 per cent; and in protected cruisers there is an increase of 16,440 tons, or 30 per cent. The total increase of the whole navy in tonnage alone is 108,320 tons, which is an increase of 48 per cent on the total tonnage with which Japan went into the war. This places her ahead of Italy, and brings her into fifth place, or next in rank to the United States.

Amundsen and the Northwest Passage.

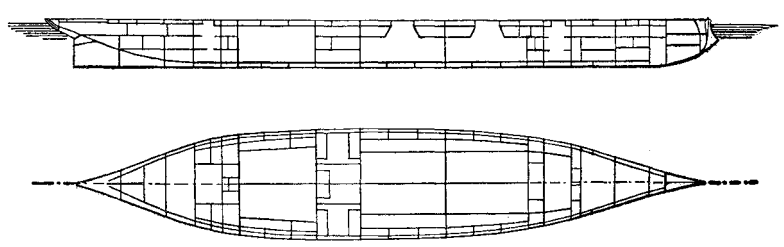
The recent reports that Capt. Roand Amundsen, of Norway, has succeeded in finding and traversing the historic Northwest Passage, and has, furthermore, definitely located the north magnetic pole, have aroused great interest in scientific circles; and while the statements are not absolutely authoritative, it is believed that the accounts cabled from Fort Egbert, Alaska, are trustworthy. The search for the Northwest Passage began almost as soon as it was established that America was not a part of Asia, but it appears, nevertheless, that Capt. Amundsen is the first to force his way around the northern edge of the continent. Notwithstanding that the accomplishment of this feat did not take place until the present day, we have known of the existence of the passage for a comparatively long period, for points which were located by travelers from the east were recognized by those from the west, or *vice versa*.

Capt. Amundsen left Norway on June 1, 1903, in his 46-ton sloop, the "Gjoa," with a crew of eight men. Crossing the Atlantic, a first stop was made at Godhaven, Greenland, and from there the party went to the island of North Somerset, near which the first base station was established. In 1904 extensive magnetic observations were undertaken at Leopold Harbor, and during the spring of the present year these investigations were carried out on King William Island, which, it is said, resulted in the location there of the north magnetic pole. It will be remembered that Capt. Ross, relying upon a single observation, claimed to have found this pole on the peninsula of Boothia, in 1831. It appears, too, that the party found on King William Island a monument erected by the ill-fated expedition under the leadership of Sir John Franklin.

Capt. Amundsen has had considerable experience in Arctic exploration work, and has received unstinted praise from his associates in former expeditions. The "Gjoa" is wintering near Kay Point, Herschel Island. The account of the expedition's successful completion was received from Fort Egbert, Alaska, and it is thought that the explorer reached that locality by an overland journey from the winter quarters of his vessel.

To Our Subscribers.

We are at the close of another year—the sixtieth of the Scientific American's life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year. To those who are not familiar with the Supplement a word may not be out of place. The Supplement contains articles too long for insertion in the Scientific American, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the Scientific American and Supplement the subscriber receives the benefit of a reduction in the subscription price.



Only the portion of the hull below the protective deck is shown. In the United States latest battleship "Connecticut" there are 101 watertight compartments above and 226 below the protective deck.

DIAGRAM SHOWING THE MINUTE SUBDIVISION INTO WATERTIGHT COMPARTMENTS OF THE "CHARLES MARTEL," A MODERN FRENCH BATTLESHIP.

Science Notes.

The interrelations of parasites and hosts, or of symbionts, are of such great physiological interest that some of the most significant problems may not justly be omitted in this connection. It has long been assumed that the conditions of nutrition of a host plant determine to a considerable extent its immunity to parasitic attack. Ward was unable to detect in the bromes any modification of resistance due to either high cultivation or to lack of sufficient mineral nutrients.

White wines are made from white grapes and such varieties of colored grapes as have practically colorless juice, the color being in the skin of the berry. The making and handling of white wine is very similar to that of red wine. The chief difference consists in the fact that, instead of allowing the crushed grapes to go through fermentation in the fermenting vats, when made from white grapes they are either allowed to remain there only a limited time (usually not more than twenty-four or thirty-six hours), or (as is most common) they are pressed at once and the juice is filled into storage cooperage and fermented by itself, the receptacles being only about three-fourths full. When white wine is made from colored grapes, in order to prevent the juice taking color from the skins, the grapes, after being crushed, must be pressed immediately. White wines, therefore, are usually not only free from the coloring matter contained in the skins, but also from the ingredients found in red wines, which are extracted from the pomace during fermentation.

A New Process or Dry Galvanizing.

At a recent meeting of the Society of Engineers in London, the new process of dry galvanizing, called "Sherardizing," was described by the discoverer of the method, Mr. Sherard Cowper-Coles. The most remarkable feature of this process is that iron and zinc can be coated with metallic zinc by the simple operation of bedding it in zinc dust in a drum, immersing it in a furnace, and then raising the zinc to a temperature which is several degrees below the melting point of that metal. Zinc dust, it may be pointed out, must not be confounded with zinc oxide, since the former consists of small particles of zinc coated with a film of oxide, and is produced by zinc distillation processes.

After immersing the articles to be galvanized, together with the requisite charge of zinc dust, in the drum, the latter is placed in the furnace. The temperature is then raised to 500 or 600 deg. Fahr.—a point some 200 deg. below the melting point of zinc. When the drum is withdrawn from the furnace and opened, the articles under treatment are found to be covered with a silvery film or coating of zinc, alloyed or amalgamated with the iron surface of the articles. The thickness of the coating can be determined as required, being simply dependent upon the length of time the drum is maintained in the furnace and the temperature employed. The advantage of this system of dry galvanizing is that the work is not only better done, but that it is considerably cheaper than hot or electro galvanizing, owing to the main fact that there is no waste of material, while the expenditure of fuel is small. Furthermore, the plant required for the purpose is both simple and inexpensive.

Another valuable characteristic of the discovery is that it can be utilized for a variety of purposes in connection with art metal work. It can be applied for the inlaying and ornamentation of metals. In this ramification of metal work the articles to be inaid are first submitted to a priming operation, being coated with a stopping-off composition, those portions where the inlay or onlay work is to be applied being removed. The articles are then packed in an iron box containing the metal to be applied in a finely-divided state, and then subjected to the furnace. Highly attractive effects are produced by inlaying steel plates with zinc, the steel being coated with magnetic oxide to render it proof against rust. Copper plate can also be inlaid with zinc, the stopping-off composition being so manipulated that a considerable portion of the copper is converted into a golden-colored brass, the effect being very unconventional and attractive. By skillful treatment and adjustment of the temperature and length of time in the stoving operations, a very extensive assortment of effects can be produced. Beautiful color schemes are obtained, ranging from silver white to yellow brasses and bronzes of a variety of shades, graduating to red copper.

For more practical and commercial operations, the process is capable of highly useful and valuable applications. It constitutes an excellent and efficient medium for case-hardening copper, and for coating aluminium preparatory to electro-plating or soldering. Iron and steel can also be rendered noncorrosive by treatment with the process. It has proved especially suitable for coating nuts and bolts, since owing to the even manner in which the zinc is deposited, the threads do not require recutting.

The Current Supplement.

Day Allen Willey opens the current Supplement, No. 1563, with an excellent description of modern methods of extracting low-grade ores as practised at Tacoma. Mr. Ernest A. Dowson continues his excellent discussion of the use of gas for power and heating. "Why Castings Curve" is the title of an article which will undoubtedly be of interest to the foundryman. Mr. John Richards recently read a splendid paper on simple steam turbine engines, before the Society of the Pacific Coast. The first installment of this paper is published. Theodore P. Shonts, of the Panama Canal Commission, writes on the work now in progress at the Isthmus. The domestic life of animals has been made the subject of an instructive article by Dr. Zell. S. F. Emmons historically considers the theories of ore deposition. A good chemical article on Porcelain is contributed by Dr. Eduard Berdel. "Thermometers, Pyrometers, and Thermo-Regulators Operated by the Pressure of Saturated Vapors" is made the subject of an exhaustive illustrated discussion. The fascinating idea that matter of all kinds has a common substratum and is subject to evolutionary laws as well as animals is advanced by Prof. George H. Darwin.

The German telegraph administration has authorized the use of portable telephones, supplied by current taken off the general circuit where required, this arrangement being specially convenient for communications with vessels at anchor in the ports.

NOVELTIES AT THE PARISIAN TOY EXPOSITION.

BY THE FRENCH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Paris is a town of expositions. Not a year passes but several bazaars and fairs are held, which are sure to offer something novel to interest even the *blasé* loungers of the boulevards. Decidedly out of the ordinary, however, was this year's toy show, at which were displayed amusing as well as remarkably ingenious contrivances.

One toy-maker exhibited a contrivance that must surely appeal to the man who loves to lie in bed o' mornings—nothing more or less than an alarm-clock which not only did its duty of awakening the sleeper, but which also ignited a small alcohol lamp and therefore cooked the aforementioned sleeper's breakfast.

Various forms of games demanding some skill in marksmanship were exhibited. Among these may be mentioned the pneumatic target of M. Henri Chasles, which he calls *Tir Pax*. The projectile, which is merely a dart, is hurled against the target either by means of a blowgun or by pressing the bulb of a pneumatic tube. The toy is so far of interest in that the target (a bear) is made of a very shaggy material to which the dart readily adheres.

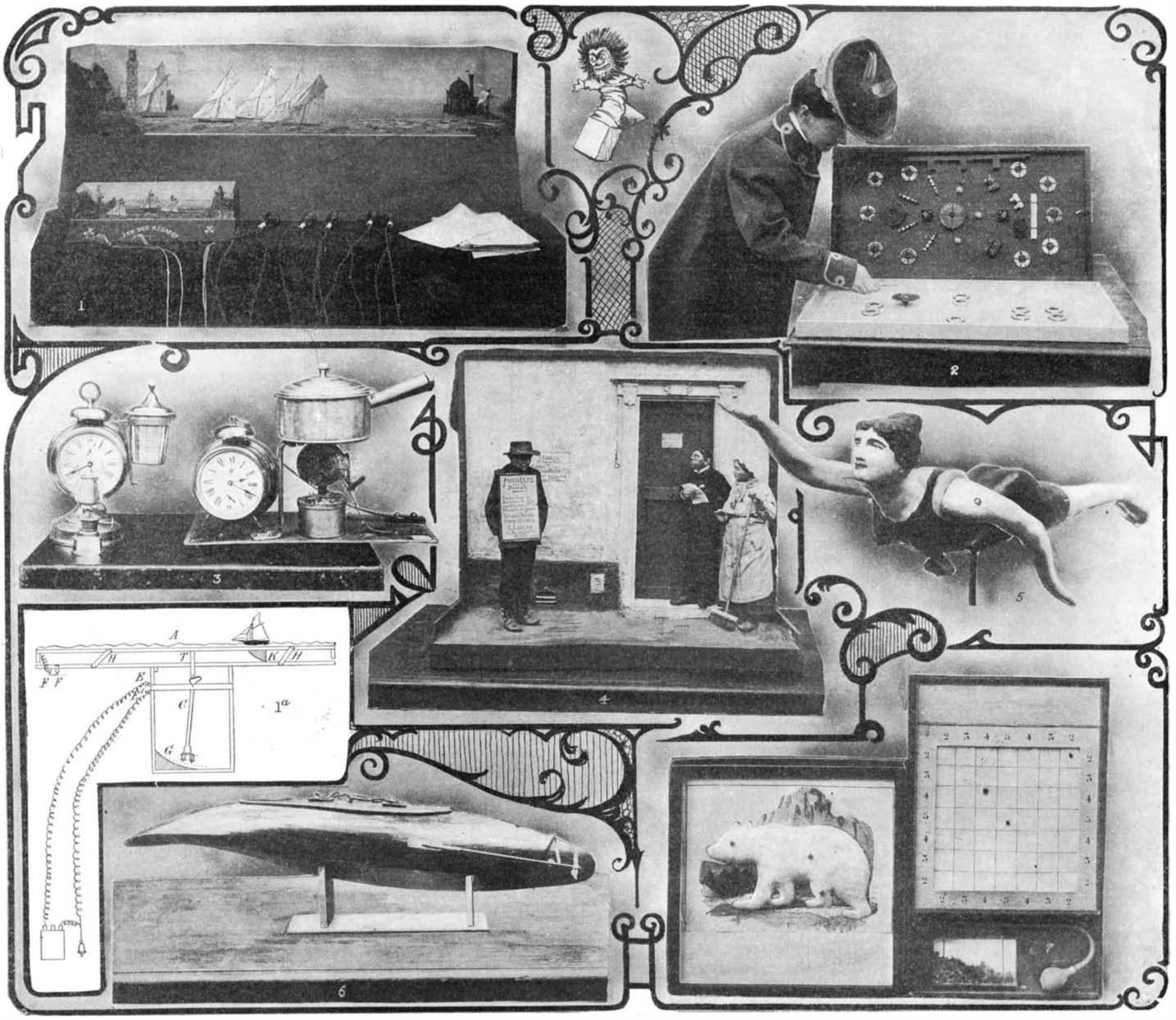
One of the most striking electrical toys at the show was the "regatta game" of M. Dauset. Five miniature boats, each controlled by a rubber tube and bulb, sailed on a painted ocean, which was really a table built on the principle of the parallel rule. Referring to the diagram (Fig. 1*a*), the parallel members of the table *A* are connected by the parallel members *H*, and represent the sea. The table is connected with a pendulum, *C*, carrying an electro-magnet, *D*, in front of which an armature, *G*, is mounted. By pressing a button, a current is sent through the electro-magnet, which is attracted by and drawn up to the summit of the armature *G*. The sea and the boat rock as the pendulum swings. Each boat has a centerboard, *K*. When the sea rises, the bow of the boat is lifted up, and the end of the centerboard scrapes the lower horizontal member of the table, *A;* but when the sea subsides, the boat plunges forward, the point of the centerboard preventing its return. When the winning boat has reached the end of its course, its keel touches the contacts *F F*, thereby releasing a flag and illuminating the lantern of a miniature lighthouse. Thereupon the general circuit is broken and the other boats remain in their places.

Not so very long ago a Miss Kellermann won a swimming race from the Pont National to the Viaduc d'Auteuil. She used what she called a "trudgeon" stroke, peculiar to her native Australia. M. Schmeltz exhibited a swimming doll which reproduced this stroke mechanically. The arms are so mounted at right angles on a shaft passing through the shoulders, that the one is always on the down stroke while the other is making the up stroke. The shaft is turned either by a twisted rubber band or a spring. The doll inclines its body just as Miss Kellermann did during the famous race and swims rapidly. Evidently the forward movement is obtained on the principle of Archimedes' screw. When the two arms are so placed that one lies alongside the body and the other is extended forward, perfect equilibrium is established and the body assumes a horizontal position. But as soon as one of the arms enters the water the equilibrium is disturbed and the body is inclined to one side. This is what actually happens in the case of a human being.

A jumping launch likewise attracted considerable attention. The model was built on the lines of a porpoise and was driven by electricity. A trial trip on the Bois de Boulogne Lake showed that the little craft could travel at the rate of twelve miles an hour.

Interesting too was a mechanical toy, which in its way acted a pantomime, the purport of which was to show that inventors are not without their trials and tribulations.

Most interesting, also, was the electric top of M. H. Chasles. It was natural enough that a sheet steel top should follow the movements of a magnet; but the strange thing about this top was that it was attracted by the magnet only when the poles were held below the disk and repelled when the magnet was held over the disk. Just why this should be so no one has satisfactorily explained. It is possible, evidently, to utilize the movements of translation for all games of skill.



1.—The Regatta Game. Each boat is controlled by a pneumatic tube and bulb. When the bulb is pressed the boat is impelled forward. The boat which reaches the lighthouse first is the winner. 2.—A game which consists in attracting and repelling a spinning steel top by means of a magnet. 3.—An alarm clock which lights a small alcohol lamp and cooks your breakfast while you dress. 4.—A mechanical puppet scene illustrating the trials and tribulations of the inventor. 5.—A cleverly designed toy which imitates the "trudgeon" stroke of the champion swimmer Miss Kellermann. 6.—A jumping boat, built on the lines of a porpoise. 7.—Pneumatic target. Darts are discharged at the cotton bear by means of a tube and bulb.

NOVELTIES AT THE PARISIAN TOY SHOW.

Exhaustive comparative tests of saturated and superheated steam for marine purposes have recently been carried out on a steamer called the "James C. Wallace." This vessel is one of the largest "freighters" on the lakes, and has lately been put into service. She is equipped with two Babcock & Wilcox marine water-tubular boilers with superheaters, and the arrangement is such that the latter may be dispensed with and saturated steam used. The engine is of the quadruple-expansion, vertical direct-acting, jet-condensing type. A comparison, based on dry coal, shows a net saving in fuel, with superheated steam, amounting to 14.5 per cent. This result represents the combined increased efficiency of machinery plant. The highest amount of superheat was 91 deg.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRIC RAIL.—L. STEINBERGER, New York, N. Y. Among the several improvements in this case Mr. Steinberger provides a system for heating the rail, thereby keeping it clear of snow and ice; renders the heating mechanism readily accessible without incurring danger on the part of operators; provides thorough insulation between the rail and its support; renders different parts of support detachable, so that the same may be taken asunder without much interruption in traffic; concentrates the heat as nearly as possible to contact-surface of the rail; confines and retains heat near contact-surface and prevents its absorption by the body portion of the rail-supports; and provides an inclosed chamber within the rail, to prevent radiation of heat except toward the contact-surface of the rail.

INSULATOR-PIN.—L. STEINBERGER, New York, N. Y. The more particular objects of this inventor are to so improve the insulation as to lessen the tendency under wet-weather conditions of a high-voltage current to arc over the surface of an insulator or its support or partly over the surface of an insulator and partly through the air from the conductor to the ground or to the support for the insulator, if this support be grounded. He also seeks to preserve the insulating device and its accompanying parts from deleterious weather action and to enable it to be used for supporting insulators or for supporting a conductor directly.

ILLUMINATING DEVICE.—A. RICHTER, New York, N. Y. The invention has reference to an illuminating device intended especially for use in connection with incandescent electric lights, but useful with other lights, if desired. It resides in certain novel features of construction and arrangement of parts, involving a rotating light by means of which the rays are projected rapidly in all directions.

Of Interest to Farmers.

HORSE-HOE.—E. A. HARVEY, Hillsboro Bridge, N. H. In this patent the purpose of the invention is the provision of a construction of horse-hoe whereby the wings can be opened and closed more expeditiously and conveniently than heretofore and wherein the adjustment of the wings can be readily made while the hoe is in operation.

HAY-PRESS.—C. COTHAM, Monticello, Ark. The invention relates to presses of the toggle-plunger type, and has for its object not only to provide a press of this character having new and improved means whereby the plunger may be operated, but also to simplify and improve the press-box, feed-door construction, and frame.

CULTIVATOR.—E. B. WINTERS, Coffeyville, Kan. The purpose of the invention is to provide a simple implement having disk cutters which can be operated either by pushing or pulling and to provide such means for adjustment of the cutters that the implement may be quickly and conveniently adapted for the cultivation of plants on a reach of level ground or in a hollow and whereby further adjustment may be made to adapt it to wide or narrow rows. It relates to hand or garden cultivators.

PORTABLE FENCE-POST.—W. R. HARRIS, Pelican, La. Mr. Harris has produced a portable fence-post and base therefor possessing advantageous features of construction and organization, and the entire structure is readily portable besides being strong, durable, and capable of withstanding strains. Members of the post can be separated from each other for any purpose, and the materials employed in constructing either post or base may be such as may be found to be best suited therefor in different localities.

Of General Interest.

OILER.—W. L. HOWLAND, Monmouth, Ill., Mr. Howland's invention relates to oiling apparatus, and more particularly to cans provided with a force-feed. The arrangement of the valve for ready cleaning, the means used for introducing the nozzle into otherwise inaccessible places, the retention of oil within the delivery-tube until the pressure generated by the piston raises the valve and forces out the oil, and the effective venting of the can, are among the advantages of this efficient device.

COKE-PULLER.—H. F. PEARSON, Redstone, Col. This apparatus is especially adapted for use in pulling coke from the ovens and loading it upon wharves or cars. The objects of the invention are to improve the construction of the device, to render it universally adjustable, so that the material may be reached at all points and from all directions, to make it easily operable by a single attendant, and to make it efficient and certain in operation.

METHOD OF REVIVIFYING SPENT CLAYS.—A. B. LATTING, Memphis, Tenn. In this patent the improvement has reference to a method for revivifying spent clays—such, for instance, as fuller's earth and other mineral substances used for purposes of absorbing grease, cleansing garments, and the like. By the means employed by this inventor the process is rendered virtually continuous.

BLANKET-PROTECTING DEVICE.—T. T. CHALONER and G. H. CHIPCHASE, New York, N. Y. The invention has reference to improvements in devices for preventing a horse from biting and tearing his blanket or clothing while in a stall and also serves as a means for preventing a vicious horse from turning his head laterally to injure with his teeth a person who may be leading him.

HARNESS-SADDLE.—G. MCMULLIN, Elk Rapids, Mich. The invention is an improvement in flexible harness-saddles. A feature is the construction and attachment of a check-line fastening or loop. Another, the construction and attachment of leather terrets. The saddle is particularly adapted for use as a coach-pad or gig-saddle. This saddle can be made for track-harness, light driving-harness, and express-harness. A similar saddle can be made for double harness, dispensing with the sliding bearing-strap.

SAND-DRIER.—W. KING, Cedar Rapids, Iowa. The principal objects of the invention are to provide means for the effective separation of sand from coarser materials mingled therewith, for drying both the fine and coarser materials, and for separating the former from the latter. Further objects are to provide means for permitting steam or any volatile matters to escape from the material operated upon, for slowly feeding the material over a drying-surface, and for effectively supporting the apparatus and applying heat in an economical and efficient manner.

BOILER-TUBE FASTENER.—A. J. ERVIN and J. R. WALKER, South Cumberland, Md. With this fastening it is unnecessary to make any change in the tube-sheets as ordinarily arranged, and the same tubes may also be used, only, furnish the separate nipple. Flues are made ready to install and necessity for rolling ends cold, is eliminated. Each tube acts as a stay, drawing the opposite sheets toward one another and preventing loosening of tubes. When these tubes are used as flues, means provide for avoiding undue expansion and contraction. Either end of the flue may be removed separately without interfering with the other parts.

FOLDING BOX.—C. B. RUTLEDGE, Tullahoma, Tenn. This invention relates to folding boxes, popularly called "knocked-down" boxes. It is intended to be especially useful as a receptacle for articles of any kind and is capable of being folded up into a compact body, which can be quickly opened out into the form of a box. The box should be especially useful for grocers, druggists, or confectioners for various purposes.

OIL-CAN.—T. B. WILKINSON, Rivera, Cal. The object in this improvement is to provide a novel construction whereby the fluid contents of the can may be forcibly ejected through the spout by a pumping action. To discharge oil the operator grasps the handle of the can and the pull-bar will press the latter up against the handle, and will eject the oil by the action of the piston through the connecting rod and spout.

SELF-MEASURING CORK.—E. S. RAYMOND and W. W. FRASER, Denver, Col. The invention relates to measuring stoppers or corks for bottles or like vessels, and the object had in view is a device of that character affording in itself the ready measuring of medicine in tea, dessert, or table spoonful. It is particularly useful to persons traveling on cars, as the jolting or vibrations thereof render it extremely difficult, if not impossible, to measure medicine with a spoon.

HAND-OPERATED PUMP.—W. H. JORDAN, Hays, Kan. The object of this invention is to provide novel features of construction for a hand-operated pump which adapt it for very convenient and effective service as an instrument for the abstraction of pus or extravasated blood from a wound, boil, or ulcer on the human body. It may be constructed in a very compact form so as to be small and light.

LAUNDRY DAMPENING APPARATUS.—H. M. FORBES, Portage, Wis. This apparatus is intended for use in applying steam or vapor to starched goods along the lines of fold in order that they may be folded without difficulty or any danger of breaking or unduly straining the fabric or fibers thereof. The invention is more particularly an improvement upon the portable hand-tool for which Letters Patent of the United States were formerly granted to Mr. Forbes.

FURNACE-FRONT.—J. BISHOP, Bartow, Fla. The invention relates to furnace-fronts; and its object is to improve the construction of this part, to increase durability, and render the fire-bed more accessible. A further object is to improve the construction of water-jacketed doors used in furnace construction. Among the many advantages, the horizontal-arch construction facilitates the care of the fire; and a certain fire-door is water-jacketed, preventing the door from becoming highly heated and warping out of shape.

MAIL-BOX.—W. O. DRESSER, Cripplecreek, Col. This box is intended for use for street and rural delivery of mail-matter. The invention provides a novel construction of box made of metal and suitably constructed of the different plates secured together. A plate may be provided in front to receive name and number. The drop-lid can be thrown open and will remain so while letters are being placed in the box. If desired it may be cast in aluminium for attachment to office-doors, club-rooms, rooming-houses, etc.

SQUARE.—D. B. LYNCH, Reno, Nev. The improvement pertains to squares, and has for its principal object the provision of such a tool by the aid of which a number of operations may be conveniently performed. In this device the handle and blade may be provided with the usual scales upon both sides, and in the handle is an opening for hanging the tool. Near the center of the handle an opening is formed to receive the level.

Machines and Mechanical Devices.

AUTOMATIC DAMPER AND VALVE REGULATOR.—C. E. SANFORD, Oswego, N. Y. This device admits of general use, but is of peculiar value in cases where the mechanism is desired to be simple and reliable, and more particularly where the apparatus is provided with electric circuits in which it is desirable to prevent the circuits from being closed by any means so as to remain closed, battery energy being thus conserved.

TREADLE-HAMMER.—C. M. NIELSEN, 3 Blaagaardsstræde, Roskilde, Denmark. In this improvement the rear end of the hammer-arm is secured to a plate spring, the lower end of which is connected through the medium of rods, and a system of similar springs pivotally mounted in the underframing to another spring is in turn coupled by a strap fitted with an adjusting-screw to a further spring movably connected at both ends to the underframing, so that the last-named springs can be brought nearer to or farther away from each other by means of the adjusting-screw, whereby the hammer can be raised to greater or less extent, according to the blow to be delivered, by depressing the treadle.

ORE-CONCENTRATOR.—M. R. LYLE, Oakland, Cal. This invention concerns itself especially with the construction of a concentrator or dry washer. The object of the inventor is to produce a device which is simple in construction and which subjects the ore-bearing gravel or earth to a succession of separations by gravitation. Means are provided for agitating the device during the concentration process.

REGISTERING DEVICE FOR PRINTING-MACHINES.—W. H. WALDRON, New Brunswick, N. J. The invention relates more particularly to such wall-paper-printing machines in which the paper is run two or more times through the machine for successive impressions. The object is to provide a registering device for multicolor-printing machines, arranged to permit a quick, convenient, and easy adjustment of the printing-rolls relative to the impression-cylinder to secure an accurate registering of the printing-rolls with a previous impression on the paper.

VOTING-MACHINE.—J. P. PAYNTER, Topeka, Kan. Among the several objects of the inventor are, first, to prevent fraudulent voting by providing certain safeguards of a mechanical nature; second, to protect the voter from espionage while giving him unrestricted choice as to candidates and parties; third, to provide certain improvements in construction and operation whereby the general purposes of a voting-machine are carried out more efficiently. The mechanisms provided are automatic.

WHEELBARROW-BEARING. — J. STANLEY, New York, N. Y. The object of the invention is to provide a bearing for wheelbarrows, hand-trucks, and other wheeled vehicles, easy to apply, and arranged to produce an equal distribution of the load on both ends of the axle, to reinforce the forward ends of the frame-beams, to insure an easy running of the wheel, and to prevent the latter from falling out or being forced out of position.

DERRICK.—E. A. SOHN, Bedford, Ind. The inventor's object is to provide an apparatus in which the source of motive power, the drums, and all of the gearing are connected with the derrick as an integral part, and all arranged to turn with the boom and mast, producing thereby a self-contained derrick and avoiding the usual practice of leading the boom and fall lines from the derrick to a power-house located at some more or less distant point from the derrick.

BRAIDING-MACHINE CARRIER.—R. HANTUSCH, New York, N. Y. The object of this improvement is to provide a carrier having an adjustable racer-base to allow of readily and accurately fitting the base on a race-plate of any desired thickness to allow of taking up wear and to permit of conveniently and cheaply renewing the base in case the same is completely worn out. A further object is to allow convenient removal of the yarn-guide for repairs or other purposes.

Prime Movers and Their Accessories.

ROTARY ENGINE.—H. M. LOFTON, ATLANTA, GA. This invention relates to a type of rotary engine in which the rotary piston has radially sliding blades adapted to be projected beyond the periphery of the piston during a portion of the revolution. A piston of this character is employed in connection with a casing of generally oblong form. The inventor provides an interior surface of the casing on certain curves of his own devising which he finds to give improved results in securing smooth and easy operation of the engine free from pounding. The engine also has various other improvements including a new arrangement of the ports, designed to balance the pressure against the blades during a portion of their travel.

Railways and Their Accessories.

SWITCH.—J. C. SCARGLE, Philadelphia, Pa. The design in this case is to automatically operate the switch by a passing car or train. The inventor's principal object is to provide means for efficiently operating the switch in a simple manner without greatly increasing the cost of the equipment, and also to improve the form of the switch itself. It is applicable to steam, electric, and in fact, all other forms of railways.

CAR-JOURNAL BOX.—A. V. PEPPARD, San Luis Potosi, Mexico. The object of this invention is to provide simple novel details of construction for a car journal-box which will permit the use therein of the standard brass and facilitate the free removal of a worn-out or split brass without excessive loss of time be merely raising the box sufficiently to remove the bearing-weight from the brass that is to be displaced, and thus enable the insertion of a new one.

RAILROAD-TIE.—J. L. CATLETT, Vincennes, Ind. Mr. Catlett's invention is an improvement in steel cross-ties. In his construction the ties are laid along the road-bed, the rails laid thereon and secured in place. No gaging is required, since the ties themselves gage the rails, and as the ties are of uniform size no blocking is required. When properly ballasted, the ties are immovable and traffic tends to fix them more securely. The track is more easily kept in shape and the rail will be free from depressions due to imperfect ties.

APPARATUS FOR LAYING AND TAKING UP RAILWAYS.—G. I. RITCHIE, Crossett, Ark. Mr. Ritchie's invention relates to an apparatus for laying down and taking up railways which is adapted particularly for use in connection with temporary roads, such as those which are constructed in lumber districts. In this industry rail or tramways are frequently laid through forests, and when the supply of timber along the road is exhausted the road is taken up and relaid, these operations frequently recurring and involving considerable expense. The object is to provide a practical means for doing this work quicker and at less expenditure. By his arrangement he is enabled with great facility either to take up or lay down a railway, dispensing with all hand-labor excepting in bolting up or unbolting fish-plates to connect or disconnect track-sections.

RAIL.—H. HERDEN, Wellsboro, S. E. FITCH, and J. H. BURGOYNE, JR., Galeton, Pa. In this patent the invention relates to certain improvements in rails, especially those for use upon railway-tracks, and includes a method of constructing a railway-track with such rails. The principal objects of the invention are to provide for more rapidly and conveniently laying rails and for more efficiently securing them in position upon the track and to each other.

RAILWAY-RAIL JOINT.—J. T. EVANS, New York, N. Y. In this instance the invention has reference to improvements in joints for railway-rails—the inventor's object being to provide a joint of novel construction that may be readily placed in position and secured without the employment of bolts as ordinarily used with fish-plate joints.

Pertaining to Recreation.

GAME APPARATUS.—W. J. HAMILTON, Franklin, Pa. The purpose here is to provide an exceedingly interesting and amusing game and one that will tax the patience of the player, in the playing of which it is required to transfer marbles or other rolling objects from a tunnel or subway to a plane surface above it, which surface is provided with openings communicating with the tunnel, the transfer to be made by shaking the device until all have passed through one at a time, it being required to keep the extracted objects upon the plane until all objects have been landed.

Pertaining to Vehicles.

COMBINATION BED AND CARRIAGE FOR CHILDREN.—S. D. CARMICHAEL, Tama, Iowa. This contrivance may be readily taken apart and folded together, either for storage or transportation of the structure, and again assembled in position for use. It affords the maximum of comfort to the occupant and may be converted into either a cariole or a bassinet when desired, and possesses all of the advantages of the indoor uses for which the latter are usually employed. It is comparatively cheap to manufacture.

BREECHING.—C. A. ACKENHAUSEN, Leavenworth, Kan. The object here is to provide a leather breeching for harness which will more effectively resist the destructive strains to which the breeching is necessarily subjected and which will also enable the breeching to be constructed more easily and cheaply than heretofore. The end is attained by forming the body and stays of the breeching of an integral section of leather, to which the holdback and hip straps are attached by rings or buckles.

VEHICLE-WHEEL.—G. L. GLASER, New York, N. Y., and J. OLSEN, Jersey City, N. J. The purpose of this invention is to provide a wheel which contains in its inner circumference, not in contact with the roadway, an elastic or pneumatic cushion which takes up and diminishes any shock or jar upon the axle as the result of the wheel rolling over uneven roadway and which contains a mechanical contrivance constructed so that the driving-hub may be instantly displaced from its center when at rest and will as quickly recover its normal center, or, in other words, the hub may assume eccentric centers to which it may be pressed by shock or jar and will instantly and automatically resume normal center.

Designs.

DESIGN FOR A CHAIR.—W. F. WITTICH, Cody, Wyo. In this instance the designer has produced a new, original, and ornamental arrangement of a chair in a very skillful and graceful manner. The whole frame is made up of antlers. The seat and back upholstered, and the latter shaped like an inverted shield, in the upper part of which a circular clock is inserted.

DESIGN FOR A ROSARY.—H. F. NEHR, New York, N. Y. The ends of the main length of this beautiful article, are brought together and fastened in a heart, pendent from which is a short continuation of the above mentioned length holding at its extreme lower end a neat and chaste crucifix.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**
MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 7570.—For manufacturers of continuous distilling apparatus.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 7571.—For manufacturers of machines for making shoe laces, corset laces, etc.

Drying Machinery and Presses. Biles, Louisville, Ky.

Inquiry No. 7572.—For manufacturers of large springs, such as are used in music boxes.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 7573.—Wanted, address of parties doing pressed metal work.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 7574.—For manufacturers of hand wagon wheels.

WANTED.—Patented specialties of merit, to manufacture and market. Power Specialty Co., Detroit, Mich.

Inquiry No. 7575.—For manufacturers of electrical novelties or burglar alarms and supplies.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company, Foot of East 138th Street, New York.

Inquiry No. 7576.—For manufacturers or dealers of plate glass; also address of firm making fancy picture and mirror frames.

I sell patents. To buy, or having one to sell, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

Inquiry No. 7577.—For manufacturers of rubber-covered casters.

WANTED.—Purchaser for Monazite, Molybdenite and Wolfram. Apply Monasite, Box 773, New York.

Inquiry No. 7578.—For manufacturers of small vacuum pumps.

FOR SALE.—U. S. Patent Right No. 730,757. Rotary roasting oven for drying grain or bakin: cereal foods. Address J. B. Galbreath, Decatur, Mich.

Inquiry No. 7579.—For manufacturers of white and colored door knobs.

A practical man wishes to invest $2,000 in a well-established machine shop. Must bear investigation. Investment, Box 773, New York.

Inquiry No. 7580.—For manufacturers of blanching machines.

I have for sale the patent of a Folding Umbrella sure to sell at sight. Offers solicited. Mrs. A. Studams, 732 Federal Street, Camden, N. J.

Inquiry No. 7581.—Wanted, address of parties who handle repairs for Swiss music boxes.

WANTED.—Ideas regarding patentable device for water well paste or mucilage bottle. Address Adhesive, P. O. Box 773, New York.

Inquiry No. 7582.—For manufacturers of practical rotary or turbine gas engines.

FOR SALE.—Paying up-to-date metal working plant-Best location; good building. $75,000, or will sell large interest to right man. Chance, Box 773, New York.

Inquiry No. 7583.—For manufacturers of blotting paper.

I have for sale the U. S. and all foreign rights of new patent Improvements in Water Tube Types of Boilers. Great economizer. J. M. Colman, Everett, Wash.

Inquiry No. 7584.—For manufacturers of lenses such as are used in miniature cameras.

WANTED.—A Young Man familiar with drafting to assist superintendent in an iron casting plant. Good opportunity for advancement if capable. Draftsman, Box 773, New York.

Inquiry No. 7585.—For manufacturers of chain-making machinery.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery tools and wood fibre products. Quadriga Manufacturing Company, 18 South Canal St., Chicago.

Inquiry No. 7586.—For makers of the instrument called the "Leak Finder," used for locating leaks in underground water mains.

Absolute privacy for inventors and experimenting. A well-equipped private laboratory can be rented on moderate terms from the Electrical Testing Laboratories, 548 East 80th St., New York. Write to-day.

Inquiry No. 7587.—For machines to make stapled and drawn push brooms.

Manufacturers of all kinds sheet metal goods. Vending, gum and chocolate, matches, cigars and cigarettes, amusement machines, made of pressed steel. Send samples. N.Y. Die and Model Works, 508 Pearl St., N.Y

Inquiry No. 7588.—For makers of rubber pillow ventilators.

WANTED.—A man of experience; capable of running a factory that is manufacturing heavy machinery. Should have $25,000 to invest in the business which can be shown to be profitable. We don't want the money without the man. The experienced man is the first essential. Address Heavy Machinery, Box 117, Station A, Hartford, Conn.

Inquiry No. 7589.—For makers of typewriter parts, such as machine parts.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

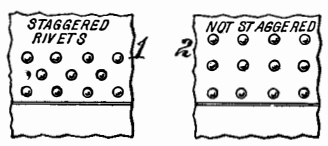
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

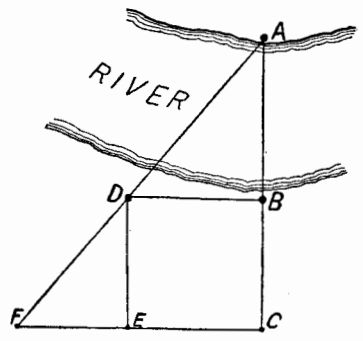
Minerals sent for examination should be distinctly marked or labeled.

(9849) W. C. N. asks: 1. What is quarry water (or sap)? What effect has it on stone, and how is it gotten rid of? A. We would say that quarry water or sap is the



water or moisture which is absorbed in stone cut from the portion of a quarry which is below the level of the ground water in the territory surrounding the quarry. Many kinds of stone are sufficiently porous to absorb a considerable quantity of water in this way. Quarry water may be got rid of by allowing the stone to season or dry out by exposure to the atmosphere. 2. Also define these terms used in construction: "Needles," "chases," "staggered." A. "Needles" are the vertical struts which are used to support or jack up a wall temporarily when the underpinning is taken out. "Chases" are cavities or recesses left in walls to receive pipes or wires. The term "staggered" is used to describe methods of spacing different articles, such as the rivets in a riveted joint of a boiler. When each rivet in one row comes opposite the space between the rivets in the adjoining row, the rivets are said to be "staggered." Fig. 2 shows three rows of rivets which are not staggered. Fig. 1 shows three rows of rivets which are staggered.

(9850) L. L. says: Some years ago the SCIENTIFIC AMERICAN gave a very simple way of measuring approximately the width of a river without any other instrument than a measuring tape. A. Select a tree or other conspicuous object on the farther bank of the



river, as *A*. Select another tree or stake on the near bank of the river, as *B*. Measure off any convenient distance—say one or two hundred feet—from *B* to the point *C*, which shall be in the line *AB*. Select a third tree or stake, as *D*, and complete on the ground the parallelogram *BCED*. Then find the point *F* on the ground which is in line with *EC* and also in line with *DA*, and measure the distance from *E* to *F*. Then *AB* will equal *BD* multiplied by *BC* divided by *EF*.

(9851) D. L. asks: 1. Kindly explain through your magazine how, by experimenting with a pendulum, it has been calculated that the gravity force of the earth is 289 times as great as the centrifugal force at the equator. A. The force of gravity at any place is determined from the time required by a pendulum of known length at that place to make one oscillation. The centrifugal force of the earth at the equator is determined from the length of the day, or the velocity of rotation of the earth at the equator. This gives the value of centrifugal force as 0.1112 of the mass of a body at the equator, which makes the body lighter by this amount. The force of gravity at the equator is 32.0902. Hence if there were no centrifugal force, the weight of a body would be the sum of these two, or 32.2014, which is the real mass of the matter of the body. Hence centrifugal force lightens a body 0.112/32.2014, which equals 1/289 very nearly. You can find all these matters demonstrated in the library of the university of your city. The librarians will assist you to find what you need, or the professor of mechanics or astronomy will advise you. Watson's "Theoretical Astronomy" will contain it. 2. From an infinite or very great distance, in an astronomical sense, our earth will attract a body with an ultimate velocity of 7 miles a second at the moment it would strike the earth. How can I find the corresponding velocity with reference to the sun and the moon? A. You will find the solution of the problem of fall from infinity in Watson as above, or in Young's "General Astronomy," Section 429. We can send you the book for $3.25. 3. If we imagine a tunnel through the earth and through its center (or 8,000 miles long), then letting a body fall into it, what would be the maximum velocity, and at what point in the tunnel would that velocity be attained? A. A body falling through the earth as you describe will have its highest velocity at the center of the earth. The finding of the velocity is a problem of analytical mechanics, to which we refer you. 4. If a bullet sent out from a rifle and in a perpendicular direction will reach a height of one mile, how far would it go at an angle of 30 degrees with the horizontal plane? A. If a bullet will rise a mile in a vertical direction, it will rise to the same distance when rising at an angle of 30 degrees to the horizon. 5. What would be the weight of a cubic foot of water at a depth of 8 miles? A. The compressibility of sea water is 44 millionths per atmosphere at 12 deg. C.; that of pure water at the same temperature is 47 millionths, while at the freezing point it is 50.3 millionths. The temperature would vary considerably as we descend in water. Upon this datum you can calculate the density at a depth of 8 miles. We must say that your questions remind us of an examination paper in college, and we never liked to take examinations.

(9852) F. L. J. asks: 1. In your issue of August 5, 1905, Query 9722, there is described an experiment with a cent and a spool. I have tried this carefully several times, but without success. Kindly give me more complete directions. A. Your failure with the spool and cent experiment is perhaps due to your having the cent too far from the end of the spool when you begin to blow. The pins should be driven into the spool so that the cent is less than a sixteenth of an inch from the spool. When you blow, the cent will then be pushed up against the spool and held there till you stop blowing, the spool being held vertically down. A disk cut from a calling card and as large as the end of the spool or larger will be drawn up from a greater distance below the spool. 2. How can I make a small transformer for transforming 110-volt alternating current to direct current of about the same voltage? A. A transformer of the ordinary sort will not change an alternating to a direct current. You require a motor dynamo for the purpose, if you wish to obtain any considerable current. For small currents you may use an electrolytic rectifier. 3. Why are permanent magnets made of steel, while the cores of electro-magnets are made of soft iron? A. If an electro-magnet is always to be magnetized in the same way, and it is not necessary to demagnetize it suddenly, the core is not made of iron but of steel. Many dynamos and motors have the field cores of steel. When an electro-magnet is to be demagnetized suddenly, as when the armature is to vibrate like that of a telegraph sounder, the core should be of soft iron in order to demagnetize it suddenly, and make the click quick and sharp. 4. Why are electro-magnets always wound with a great deal of fine wire? A. Electro-magnets are not always wound with many turns. They are wound with the calculated number of turns to produce the degree of saturation necessary for their work. 5. Would they not give as good results if wound with a few turns of heavy wire, provided the number of ampere turns was the same in each case? A. Electro-magnets are not wound with any coarser wire than can be avoided, in order to keep the current as low as possible for the work to be done. The heating is in proportion to the square of the current, hence with twice the current there will be four times the heating. For this reason a larger number of turns of finer wire are better than a smaller number of turns of coarse wire. 6. Can the speed of an induction motor be lowered with a resistance in series with it? A. The speed of an induction motor may be altered in a number of ways. One of these is by a controller similar to that of a trolley car in the motor circuit. These methods of control are quite fully explained in Oudin's "Polyphase Apparatus and Systems," which we can send you for $3.00.

(9853) J. C. H. writes: I saw an article No. 9806, page 306, dated October 14, 1905, in which R. L. I. asks a question about potential energy, and your editor says he did not know the definite answer. The following solution is the most plausible. When the coiled spring is placed in the tube and acid put on, a certain portion is dissolved, say the millionth part of a cubic centimeter. This gives a millionth part of a cubic centimeter in which the remainder of the spring can uncoil and exert its energy. In this way the dissolved portion is always giving room for more expansion. The questioner asks whether the heat in the coiled spring is greater than in an uncoiled one. This difference is so small and would amount to such an infinitely small amount, that it could be left out of question. A. If the explanation of the case of the coiled spring dissolved in acid as given above satisfies our correspondents, we are quite satisfied that they should adopt it. It is a case for quoting Mr. Lincoln's famous certificate of recommendation of something which was presented to him: "If this is the sort of a thing a man would like, this is just the thing he would like." We should not expect the spring to behave that way. We should expect it to grow weaker as it became thinner during its solution till at last it would have no elasticity left with which to uncoil. Its reaction against the band which held it would diminish till nothing of the steel was left.

(9854) W. B. S. says: In the edition of your paper of July 15, 1905, question No. 9693, F. L. asks whether a bullet dropped from the muzzle of a rifle would reach the ground quicker than one fired from the rifle at the same elevation with the rifle held perfectly horizontal. I understand your answer thereto, but to my mind it does not explain all the factors entering into the problem. For instance, the bullet fired from the rifle is acted upon by two forces, i. e., the propelling force of the powder which forces the bullet in a direction diagonal to the pull of gravity, and the pull of gravity; whereas the bullet dropped from the muzzle of the rifle is acted upon by the one force only, i. e., the pull of gravity. It thus seems to me self-evident that when the bullet is fired from the rifle there is a force behind it which in a degree counteracts the pull of gravity, that is, this horizontal force would tend to keep the bullet in the air longer than would be the case without this force. Moreover the bullet traveling in a horizontal direction would consume the extra time necessary to cover the horizontal distance, whereas the bullet dropping from the muzzle would have only the perpendicular direction to the earth. Why would it not then require less time for the bullet to travel the perpendicular than the oblique distance? Would the speed of the bullet fired from the rifle or the resistance of the atmosphere enter into the problem as factors? A. The problem of the motion of a rifle ball shot horizontally and another dropped vertically is a very old one, and there is no disagreement among scientific men regarding it. All the books say the same about it, that both balls keep in the same horizontal plane as they move. The force of the powder drives the bullet horizontally and has no influence upon its downward motion. It falls by gravity alone, just as the one dropped vertically does. As you say, there are two motions in the bullet which is shot and one in the one which is dropped. This statement makes the whole matter plain. The writer has performed the experiment probably thousands of times, and never with any deviation in the result. Both balls strike the ground at the same time. Neither the difference in the speed of the two bullets nor the resistance of the air is concerned in the motion of the bullets. Gravity draws each down the same distance in the same time.

(9855) O. F. N. writes: Question No. 9806, asked by R. L. I., about the energy of a coiled spring, seems to me to be of great importance. The energy must be somewhere, even if the spring is dissolved in some acid. That is my opinion. I have formed theories about that which I hesitate to advance, as I am inclined to believe that you would not publish the same, as these theories seem to be against your own judgment that nobody knows it. A. We are not looking for theories as to the energy of the coiled spring dissolved in acid, but for facts. Has anyone measured the recovery of the energy during solution, to tell us what becomes of it? One speculation is no better than another if given by a person who has not experimenetal evidence to offer in support of his inference. It is not a question of our own judgment, but one of experimental evidence. Anyone having experimental evidence on the matter can have a hearing.

(9856) G. B. asks: In projecting a lantern slide upon a screen with a single double convex lens the lines on the picture, when viewed close to the screen, within a foot or two, give the colors of the rainbow. If, however, the observer goes back ten or twenty feet more from the screen all this color effect immediately disappears. Will you please explain why this color effect is not equally visible at this distance. I understand, of course, if a chromatic lens is used there will be no such color effect. What I do not understand is why, when you see it so plainly at a foot away, you cannot see it equally plainly at 10 feet, although all the other parts of the picture are equally visible at either distance. A. The lines of a picture are visible to the eye when a line subtends an angle at the eye of about a minute of arc. This is the limiting angle of vision without optical assistance. When one stands one foot from the screen on which is a picture with lines projected by an ordinary convex lens, the lines fill more than this angle. So also do the interference fringes on the edges of the lines. At 20 feet distance from the screen a space twenty times as broad is required to fill the same angle as was filled by a line at one foot distance from the screen. All which is in the wider space is combined in the eye at 20 feet into an image of the same size as was occupied by the line at 1 foot. The color fringes then are combined into white light again, and only the black is seen. If one uses an opera glass at 20 feet the colored fringes are restored and are as visible as at the 20 feet divided by the magnifying power of the glass. If a glass magnified five diameters the lines and fringes appear as when seen at a distance of 4 feet. The restoration of the colors by the opera glass constitutes rather a pretty optical experiment.

NEW BOOKS, ETC.

PAINTERS' OILS, COLOURS, AND VARNISHES. Edited by Paul N. Hasluck. Philadelphia: David McKay, 1905. 12mo.; pp. 156. Price, $1.

This work is a digest of information contributed by experienced chemists and color manufacturers, scattered through the columns of the building world, and gives concise data on the general principles and practice of the subject, in a form convenient for everyday use. Numerous diagrams and engravings illustrate the text, and a carefully-arranged index adds to the value of the book.

THE CHRYSANTHEMUM. By Arthur Herrington. New York: Orange Judd Company, 1905. 8vo.; pp. 158. Price, 50 cents.

A practical treatise on the propagation, cultivation, training, raising for exhibition and market, hybridizing, origin, and history of the chrysanthemum, written to show that not in secret arts and practices, but in a plain course of procedure, are attained the results as demonstrated. The text is illustrated with numerous engravings.

BEGINNER'S MANUAL OF SUBMARINE CABLE TESTING AND WORKING. By G. M. Baines. New York: The D. Van Nostrand Company. 12mo.; pp. 217. Price, $3.50.

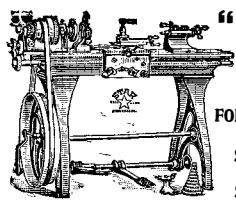
Many apparently formidable difficulties are encountered by those who turn their attention toward acquiring the knowledge necessary to the theoretical and practical mastery of this subject. The mass of information that confronts them, while it cannot be ignored, is hard to systematize and harder still to assimilate. Wherever possible arithmetic is used instead of algebra, and where algebraic formulas must be given, they are presented in a clear and simple manner, thus making progress easy for those not far advanced in algebra. The book will appeal to the beginner in submarine cable testing and working.

TOOLS FOR ENGINEERS AND WOODWORKERS. By Joseph Horner, A.M.I.Mech.E. New York: D. Van Nostrand Company, 1905. 8vo.; pp. 340; 456 illustrations. Price, $3.50.

This book gives an account of such tools as are commonly used by engineers and woodworkers, and is written principally from the standpoint of men who have to use them, and who desire to understand the principles which underlie the forms in which those tools are found. Practical instructions for their employment have been added. The work is comprehensive in its scope, and the subject of Instruments of Measurement is treated in a very full manner, and freely illustrated with drawings of leading types.

HYDRAULIC TABLES. By Gardner S. Williams, M.Am.Soc.C.E., and Allen Hazen, M.Am.Soc.C.E. New York: John Wiley & Sons, 1905. 8vo.; pp. 75. Price, $1.50.

These tables show the loss of head due to the friction of water flowing in pipes, aque-



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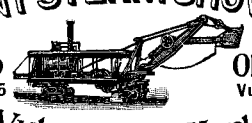
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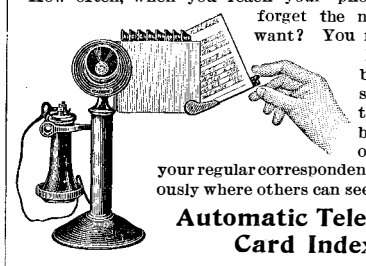

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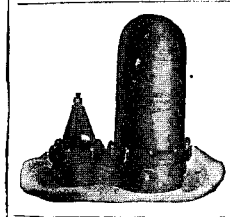

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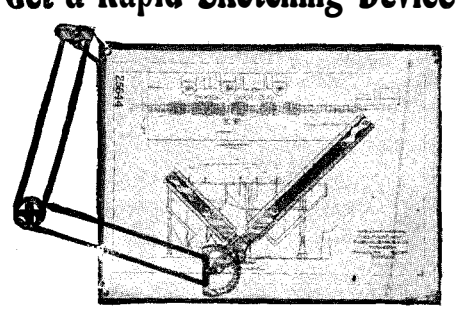

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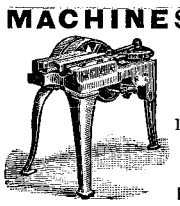

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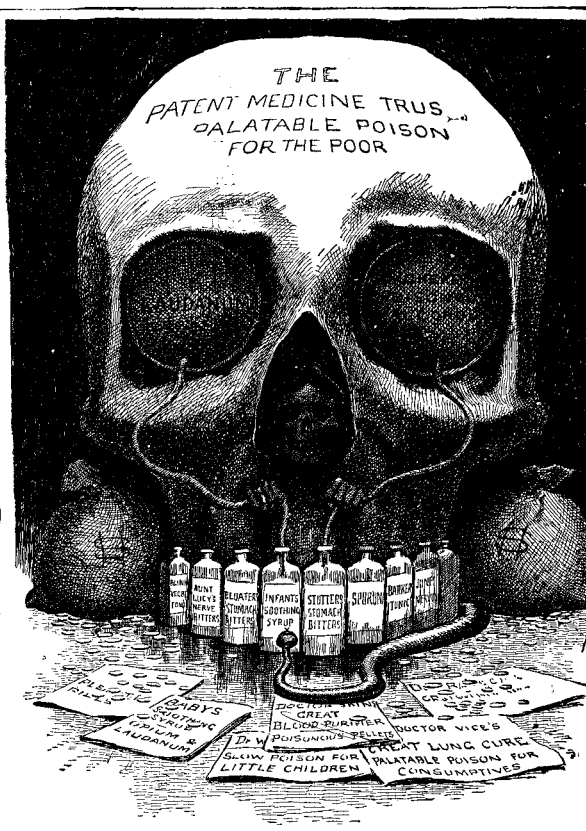
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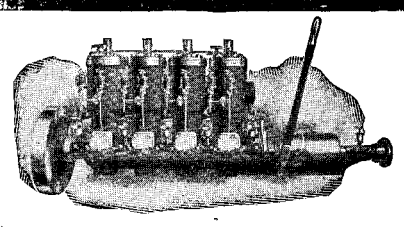

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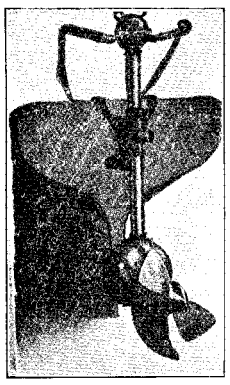

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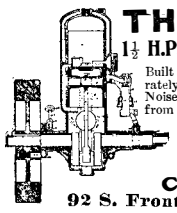

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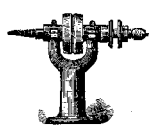

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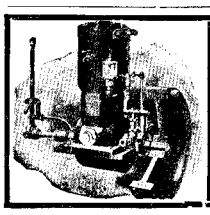

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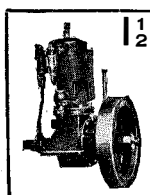

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ducts, sewers, etc., and the discharge over weirs. All the computations of figures contained in this volume, except a few fundamental ratios, have been made with the slide-rule, and only such accuracy has been sought as can readily be obtained by this method. To the hydraulic engineer the tables will prove a source of reliable data.

THE COPPER HANDBOOK. Vol. V. Compiled and published by Horace J. Stevens. Houghton, Mich., 1905. 8vo.; pp. 882. Price, $7.50.

This, the fifth edition of the Copper Handbook, represents a year of careful, steady work. A great mass of material from thousands of different sources has been closely examined, the most important facts gathered therefrom, and verified as fully as possible. Statistics have been furnished by a great majority of the officials of the various governments. Like its predecessors, this volume has been written along systematic lines. The work of passing upon the honesty and responsibility of various mining companies has been carried much further this year than in any preceding edition of the book. There are very full and interesting chapters on the History of Copper; Geology of Copper; Chemistry and Mineralogy of Copper; Metallurgy of Copper; Uses of Copper, etc. The chapters on the Copper Deposits of South America, Europe, Africa, Asia, Australia, and Oceanica contain much valuable and thoroughly up-to-date information. An index worthy of the book is given.

SOILS AND FERTILIZERS. By Harry Snyder, B.S. Easton: Chemical Publishing Company, 1905. 16mo.; pp. 294. Price, $1.50.

A knowledge of the contents of this book would go far toward making a good farmer. The work includes all of the topics and laboratory practice relating to soils as outlined by the Committee on Methods of Teaching Agriculture appointed by the Association of Agricultural Colleges and Experiment Stations.

SECOND YEAR CHEMISTRY. A Handbook for Laboratory and Class Work. By Edward Hart, Ph.D. Easton, Pa.: Chemical Publishing Company, 1905. 16mo.; pp. 165. Price, $1.25.

The author has produced a valuable little textbook, in which one of the salient points dwelt upon is the extreme care necessary in qualitative as well as quantitative analysis. The book will prove of value in all schools.

THE CEREALS IN AMERICA. By Thomas F. Hunt. New York: Orange Judd Company, 1904. 12mo.; pp. 421. Price, $1.75.

A very valuable book, dealing with an agricultural subject of vast importance. The cereals have been treated principally with reference to their American environment, although valuable foreign data has often been included. It should form a textbook for all agricultural schools and colleges. The entire subject, from the planting of the seed until the finished product is marketed, is ably discussed.

METHODS OF ORGANIC ANALYSIS. By Henry C. Sherman, Ph.D. New York: The Macmillan Company, 1905. 8vo.; pp. 245. Price, $1.75.

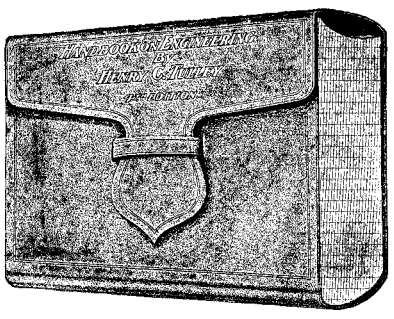
The purpose of this work is to give a connected introductory training in organic analysis, especially as applied to plant and animal substances and their manufactured products. The greater part of the book is devoted to quantitative methods for food materials and related substances. It will prove an excellent textbook, and the description of methods was written primarily for the use of third-year students in the School of Chemistry, Columbia University.

THE SYNTHETIC DYESTUFFS AND THE INTERMEDIATE PRODUCTS FROM WHICH THEY ARE DERIVED. By J. C. Cain, D.Sc., and J. F. Thorpe, Ph.D. London: Charles Griffin & Co., Ltd. Philadelphia: J. B. Lippincott Company, 1905. 8vo.; pp. 405

This book is designed to serve the purposes of a laboratory textbook for the use of students in the chemical laboratories of technical schools and of colleges where technical subjects, connected with this branch of higher organic chemistry, are taught. A theoretical knowledge of chemistry is presupposed. To all who are in any way interested in the subject of dyestuffs, we can confidently recommend this work

A MANUAL OF MINING. By M. C. Ihlseng, C.E., E.M., Ph.D., and Eugene B. Wilson, Mining and Metallurgical Engineer. New York: John Wiley & Sons, 1905. 8vo.; pp. 723; 337 figures. Price, $5.

This book is based on a course of lectures upon mining, delivered at the School of Mines of the State of Colorado, and is issued with the advice of its board of trustees. Part I. contains a brief geological review and a discussion of such points as the engineer must include in his report, that is, the preparatory and development work, systems of mining and the plant for power, hoisting, pumping, and ventilation. Part II. embraces the practice of prospecting, drilling, blasting, shafting, tunneling, and timbering, in addition to some remarks upon the examination of mines. Although designed as an elementary treatise for the use of those desiring a reference book, the book contains, within a moderate compass, the



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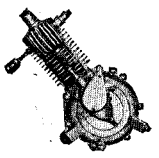

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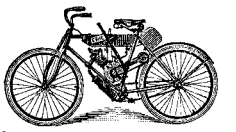

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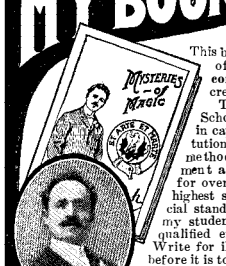

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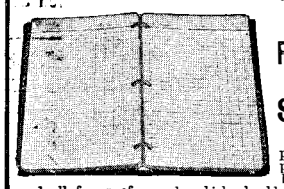

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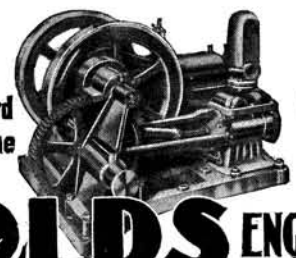

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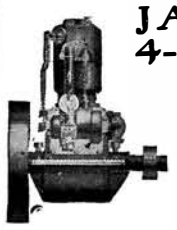

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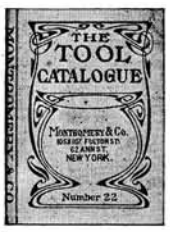

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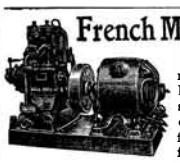

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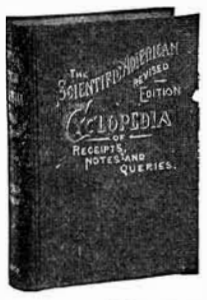

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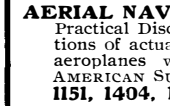

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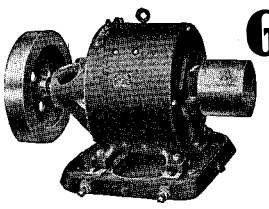

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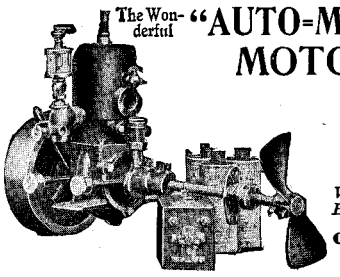

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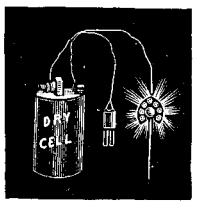

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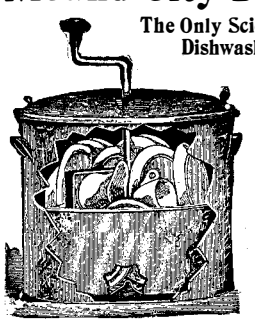

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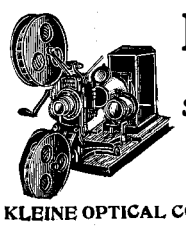

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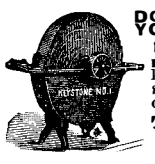

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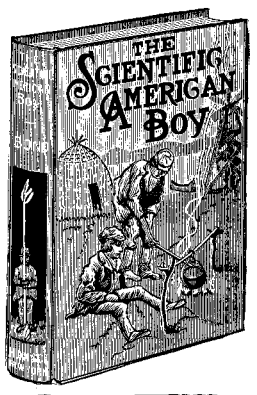

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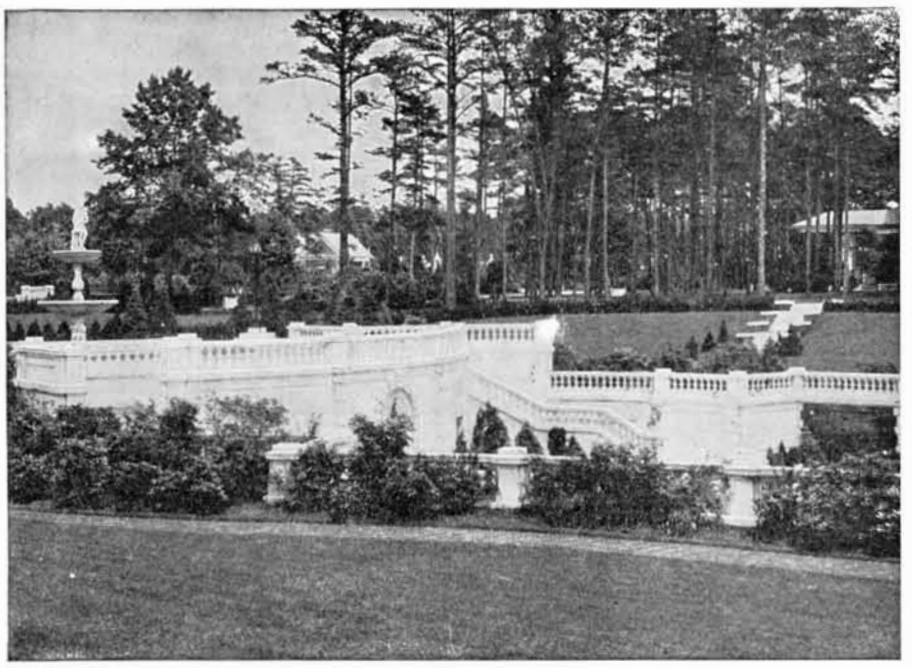

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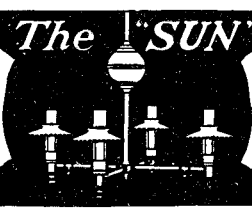

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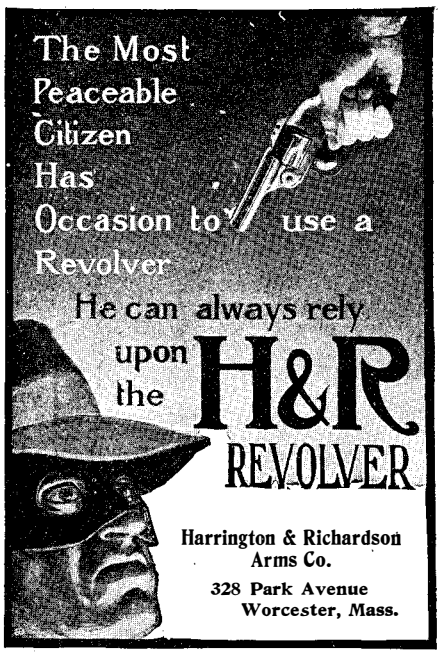

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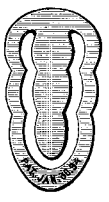

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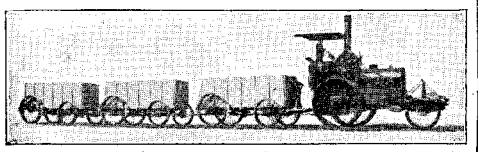

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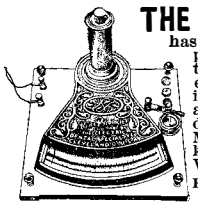

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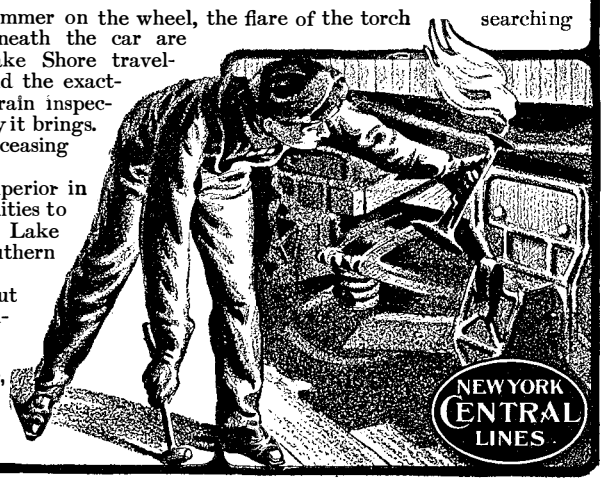

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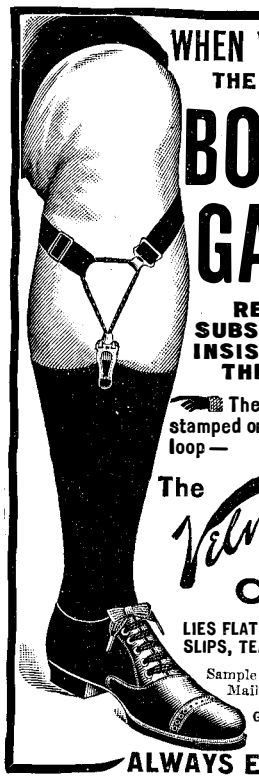

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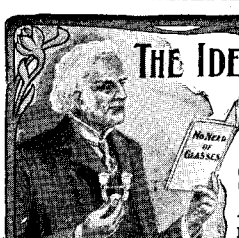

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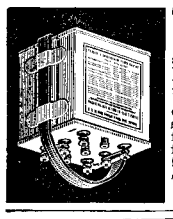

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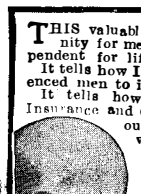

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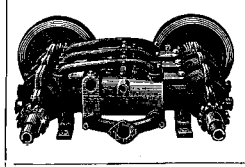

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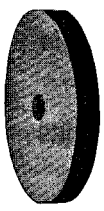

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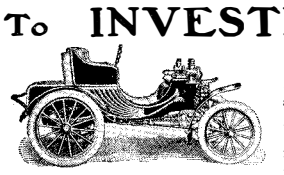

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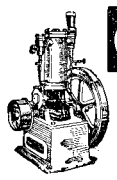

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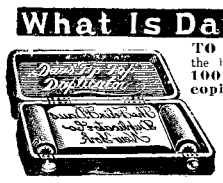

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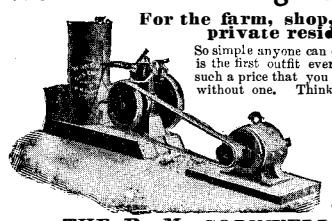

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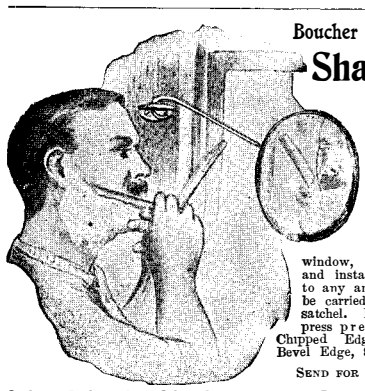

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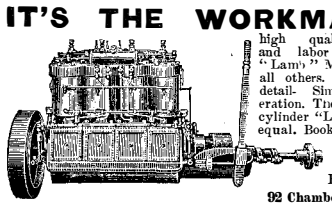

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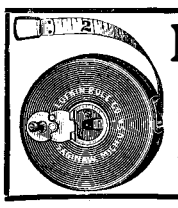

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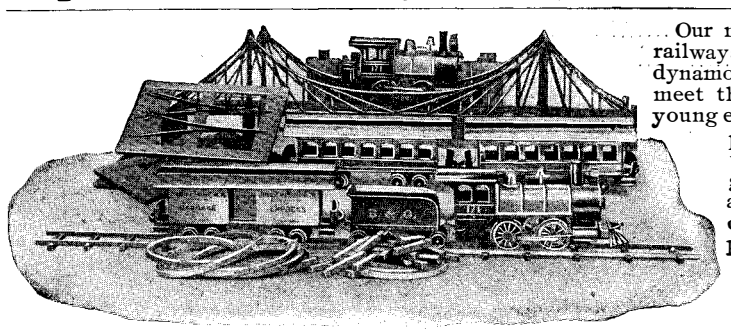

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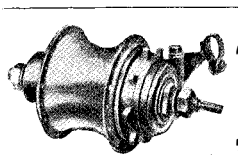

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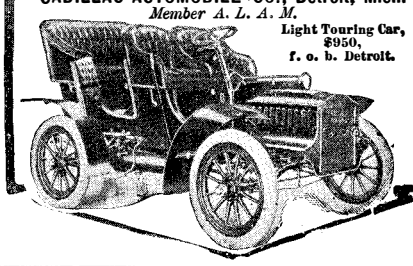

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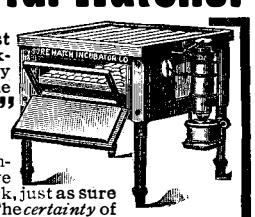

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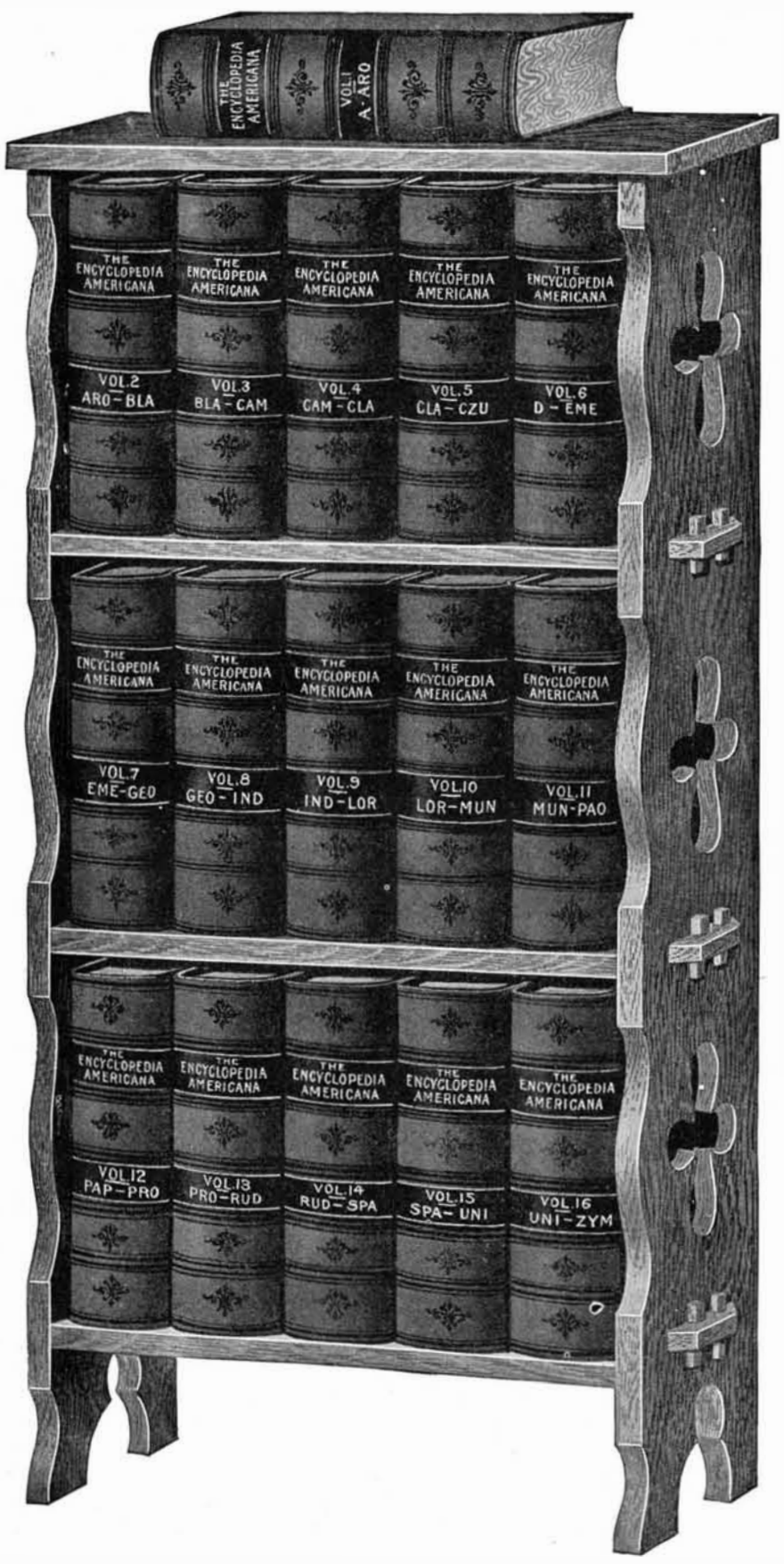

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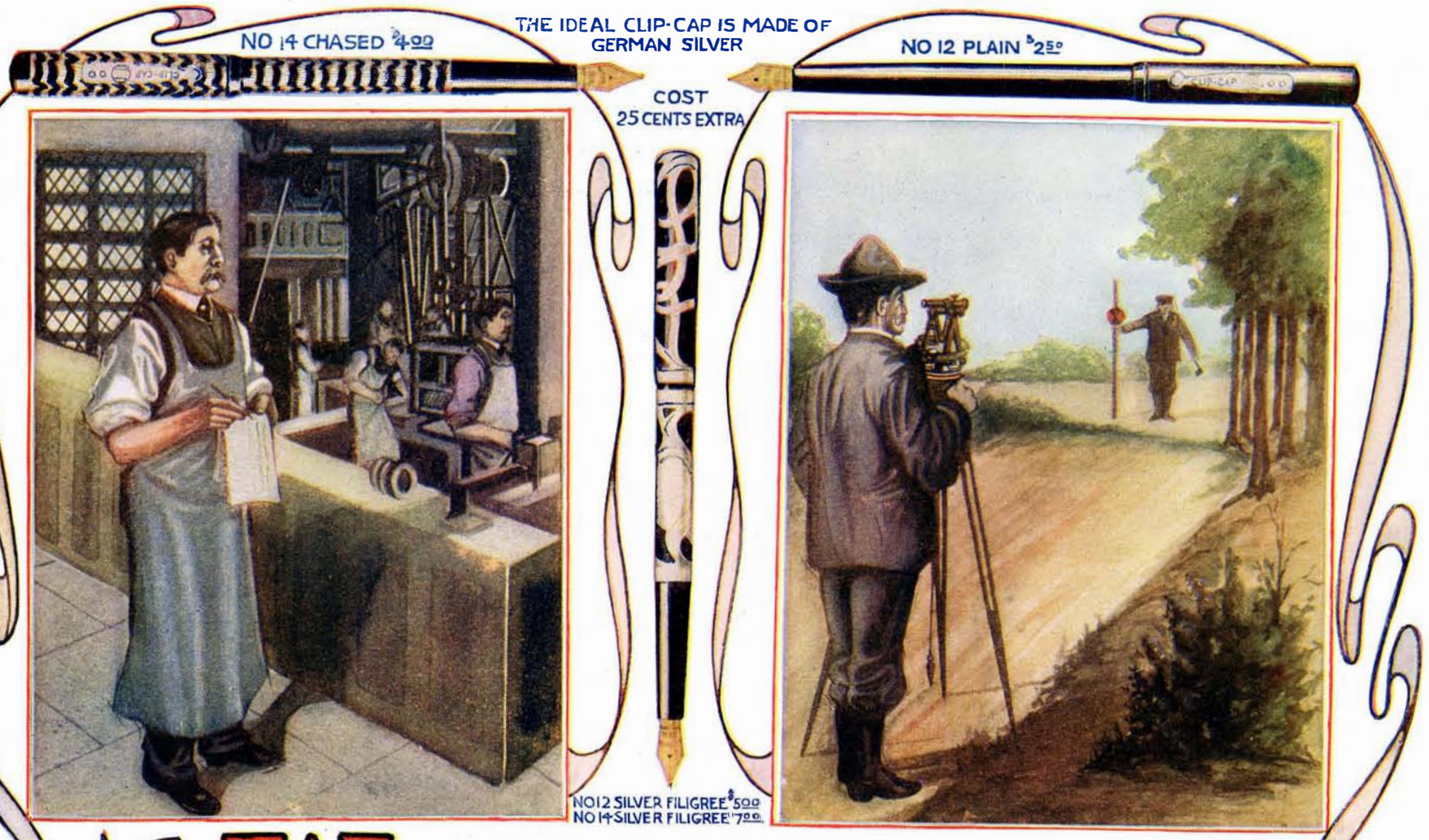
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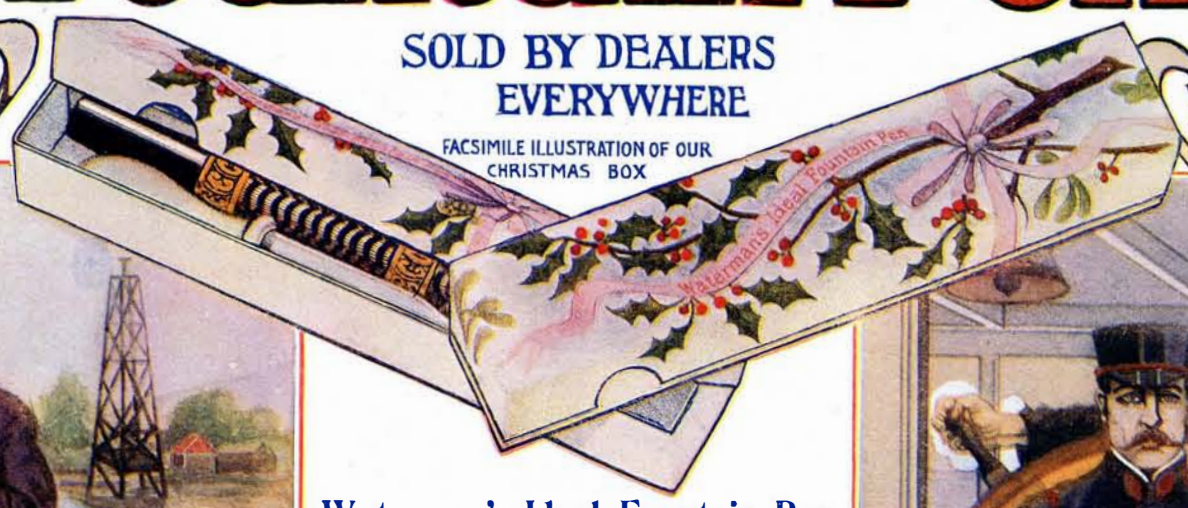

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